POST-DISASTER RECOVERY PLANNING AND SUSTAINABLE DEVELOPMENT – A LESSON FROM THE WENCHUAN EARTHQUAKE, CHINA, 2008

BY

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THESIS

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ABSTRACT

In May 12, 2008, Wenchuan was hit by a Mw 7.9 earthquake, which affected 170,000 square miles areas and caused more than 88,000 deaths. The Chinese government responded immediately after the earthquake. Under the hierarchical top-down political structure, central government established a special intergovernmental partnership system to formulate and implement the post-recovery planning and reconstruction in a short time. However, disaster recovery is a complex process which involves not only physical reconstruction, but also social reorganization, economic recovery, and cultural heritage. Due to the vulnerable and complex situation of the disaster-affected areas, it is very important for them to achieve long-term recovery and ultimately, sustainable development. Under this circumstance, can the Chinese government reach the goal which aims at gaining the transition "from blood transfusion to blood reconstitution" during the fast-speed Wenchuan post-disaster reconstruction process?

This thesis focuses on the evaluation of the Wenchuan post-earthquake recovery and reconstruction planning by applying the criteria of sustainable development and exploring its underlying issues given the large context of the changing political, historical and economic environment of China. The planning is primarily evaluated from three aspects, including planning content, planning formulation process and planning implementation. 13 reconstruction plans of towns in Wenchuan County are closely examined both qualitatively and quantitatively. Based on the evaluation results, the conclusion discusses some implications of a proper post-disaster planning mode to achieve sustainable development.

To father and mother

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CHAPTER 1

INTRODUCTION

1.1 Background

According to the *White Book of China Disaster Alleviation Action* released by the Press Office of State Council[1] of China in May 2009, more than 70 percent of the cities and more than 50 percent of the population in China are located in areas which have frequent disasters (State Council, 2009). Currently, China is undergoing a particular development period which is characterized by rapid urbanization and industrialization. Under this circumstance on one hand, the frequent large disasters have been regarded as a possible impediment to the continuous economic growth of China; on the other hand, it is also increasingly important for China to strengthen the capability of disaster mitigation and prevention, as well as the measures for post-disaster emergency response and reconstruction to avoid or minimize the loss brought by disasters in the future.

On May 12, 2008, Wenchuan was hit by a Mw 7.9 earthquake (China Earthquake Administration, 2008). According to the official figures released by Ministry of Civil Affairs[2] up to August 11, 2008, 12:00 CST, 69,225 are confirmed dead, 374,640 injured, and 17,939 listed as missing, while the total affected area is estimated at 170,000 square miles (*Sohu's*, 2008). Under the hierarchical socialism system, the central government of China soon established a special intergovernmental partnership system to formulate and implement the post-recovery planning and construction. This system aimed to achieve rapid reconstruction with high quality while making full use of nation-wide resources. In the National Wenchuan Overall Planning for Post-Wenchuan Earthquake Restoration and Reconstruction (2008), China set up the goal to finish detailed reconstruction planning in three months and the overall reconstruction work within three years.

However, it is well known that disaster recovery and reconstruction is a long-term process which involves physical reconstruction, economic recovery and social reconstruction. Under the context of disaster

[1] The State Council of the People's Republic of China is the chief administrative authority of the People's Republic of China. It is chaired by the Premier and includes the heads of each governmental department and agency. In the politics of the People's Republic of China, the Central People's Government forms one of three interlocking branches of power, the others being the Communist Party of China and the People's Liberation Army. The State Council directly oversees the various subordinate People's Governments in the provinces, and in practice maintains an interlocking membership with the top levels of the Communist Party of China creating a fused center of power. (Retrieved from: http://www.gov.cn/zwgk/2008-07/17/content_1047512.htm)

[2] The Ministry of Civil Affairs of the People's Republic of China is a ministry under the jurisdiction of the State Council of the People's Republic of China, responsible for social and administrative affairs. Retrieved from http://www.mca.gov.cn/

recovery, the concept of sustainable development is of the utmost importance for the disaster-affected area, since the ultimate goal of post-disaster reconstruction is not only to guarantee the full recovery of disaster-affected areas, but also to maintain the capability and potential to develop independently in the future. The latter is well defined by the concept of sustainable development as "a development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development, 1987, p. 8). It is meaningful and important to examine whether this unique Chinese mode of Wenchuan post-earthquake reconstruction could effectively achieve the goal of sustainable development. Similarly, this particular case of Wenchuan post-earthquake reconstruction may also provide many precious implications to the contemporary study of post-disaster reconstruction worldwide.

1.2 Research purpose

This thesis will primarily focus on the evaluation of Wenchuan post-earthquake recovery planning by using the criteria of sustainable development and the discussion of its underlying issues given the particular context of the changing political, historical and economic environment of China. 13 town recovery plans within Wenchuan County will be closely examined in detail. This thesis will achieve two major objectives:

- Establish an evaluation system for sustainable post-disaster recovery and reconstruction planning and apply it to the evaluation of post-earthquake recovery and reconstruction plans of Wenchuan County.
- Discuss the advantages and disadvantages of the Wenchuan mode of post-disaster recovery under the centralized political system by applying the criteria of sustainable recovery.

The particular mode of Wenchuan earthquake recovery has revealed many underlying issues. To achieve the major objectives, this thesis will answer the fundamental question: *What is the proper planning mode and process that can achieve sustainable disaster recovery and reconstruction?*

Based on this question, this thesis explores three categories of more specific questions as well as some related hypotheses:

Questions focused on the evaluation system of sustainable post-disaster recovery and reconstruction:

- What are the particular characteristics of post-disaster recovery and reconstruction?
- How are sustainable development and sustainable post-disaster recovery and reconstruction defined?
- How is the sustainability of post-disaster recovery and reconstruction evaluated?

There are several established models and theories of sustainable development focused on urban planning and post-disaster reconstruction planning. Combined with the particular characteristics of disaster recovery, it is possible to establish an evaluation system to assess both plan contents and planning process under the criteria of sustainable recovery.

Questions focused on the evaluation of post-disaster recovery and reconstruction plans of Wenchuan post-earthquake recovery:

- What are the evaluation results of Wenchuan post-earthquake recovery and reconstruction plans, planning formulation process and planning implementation based on the criteria of sustainable disaster recovery?
- Are there any underlying issues that contribute to the evaluation results?

It is assumed that the particular planning mode of the Wenchuan Earthquake recovery, including both of the top-down centralized planning and the paired-assistant mode, is deeply embedded in the political and economic context of China.

Questions focused on the strategies of improving the existing disaster recovery mode in China and achieving the goal of sustainable development:

- What are the fundamental attributes that contribute to these advantages and limitations?
- How can China improve the existing planning process to make the post-disaster recovery and reconstruction plans more sustainable?

CHAPTER 2

LITERATURE REVIEW

2.1 Post-disaster recovery and reconstruction

Study of post-disaster recovery and reconstruction is a new topic in recent decades. Before the 1970s, very few studies examined the dynamics and processes of post-disaster recovery and reconstruction. Meanwhile, many scholars have pointed out that most studies about post-disaster recovery and reconstruction are focused on individual cases, which often lacked systematic comparative studies and had difficulty in generalizing with other case studies involving other disasters (Rubin, Saperstein, & Barbee, 1985; Olshansky, 2005). However, after several years of development in this new field, a considerable consensus exists in the literature regarding a variety of recovery issues (Olshansky, 2005), which helped to guide subsequent studies.

2.1.1 Processes of disaster recovery and reconstruction

Disasters occur when the built environment is hit by either a manmade or natural disaster event and human lives are affected (Schwab &Topping, 1998). Disasters will cause both physical and socio-economic damage in the affected areas and could impact every aspect of the whole urban system. Accordingly, disaster recovery is usually characterized as a long, complex, difficult and often chaotic process, which not only includes the physical repair and reconstruction, but also the more challenging reorganization and reestablishment of the entire damaged socio-economic network in the affected area. Meanwhile, the scope of recovery is very broad, and the process always involves a series of ongoing and related processes; almost all of these events happen at the same time and last for various lengths of time beyond the event (Schwab, et al, 1998).

The process of disaster recovery and reconstruction could be divided into several stages based on their characteristics and particular tasks. Haas, Kates, and Bowden (1977) divided disaster recovery into four overlapping periods: emergency period; restoration period; replacement and recovery period; and commemorative, betterment, and developmental reconstruction period. Schwab, et al. (1998) provided a similar period division and furthermore gave a timeline for each period. Combining the two studies, the timeline and content of post-disaster recovery and reconstruction could be summarized as follows:

Figure1:Post-disaster recovery and reconstruction time table

Haas, et al.(1977)	Schwab, et al. (1998)	Timeline	Activities
Emergency period	Emergency	1-15days	Covered the initial hours or days following the disaster when the community was forced to cope with its losses in property, lives, and injuries and when normal activities were disrupted.
	Preparation of damage survey repots	1-4 days	
	Preliminary damage assessment	1-10days	
	disaster declaration	1-21days	
Restoration Period	recovery	7-150days	covered the time following the emergency period until major urban services and transportation returned, and rubble was removed
Replacement reconstruction period	short-term reconstruction	70-200days	The city rebuilt its capital stock to pre-disaster levels and social and economic activities returned to their previous levels. Signs of its completion included the return to pre-disaster population levels and the replacement of homes, jobs, and urban activities
Commemorative betterment, and developmental reconstruction period	Long-term reconstruction	100days to 5 years	When major reconstruction activities took place, and future growth and development began to take hold.

However, it is widely regarded that there are no clear lines between the emergency period, short-term recovery period and long-term recovery and reconstruction. Except the emergency period, many aspects of the following recovery and reconstruction process may overlap more extensively than theory suggests **(**Schwab, et al. 1998**),** since these aspects are largely dependent on the communities' ability to access resources and power. Therefore, different parts of a community could be in different stages at the same time (Rubin, et al., 1985).

It is difficult to define whether a post-disaster recovery and reconstruction is successful since the recovery process largely depends on local and national socio-economic and political context (Olshansky, 2006). However, at a minimum, the disaster-affected areas should achieve the goal of the first two stages of post-disaster recovery and reconstruction: that is, to return to the previous level of economic function and finish the physical reconstruction including housing, infrastructure, and public facilities. Despite the differences based on various local conditions, the typical goal of physical recovery is clearly defined and could be achieved within a stable period. However, the ultimate goal of a complete post-disaster recovery and reconstruction process is to achieve long-term reconstruction, that is, "to make the new permanent city the best it can be with a sustainable development pattern" (Olshansky, 2006, p148). Consequently, even though a disaster-affected area usually could receive a significant amount of outside resources and assistance within several years, ultimately, it still needs to develop independently in the long run. Hence,

the method through which disaster-affected areas achieve sustainable and independent development becomes a complicated, lasting and challenging goal during the whole process.

2.1.2 Opportunities for disaster recovery and reconstruction to achieve change and development

Although disasters seriously damage the affected areas, many studies have also shown that disasters may bring particular opportunities to those areas to solve pre-existing problems and achieve remarkable changes and improvements during the recovery and reconstruction process, which is widely defined as "the window of opportunity that opens following a natural disaster" (Birkland, 1997; Godschalk, Beatley, Berke, Brower, & Kaiser, 1999; Olshansky & Kartez, 1998; Burby, 1998; Passerini, 2000). It is pointed out that natural hazards are usually not high on the political agenda because they occur infrequently and are overshadowed by more immediate, visible issues; furthermore, even if local governments have realized the issue, there may still be not enough concern for actual action (Burby, 1998). Under this circumstance, a disaster could serve as an effective alarm by revealing existing problems to the public and governments, thereby pushing them to take actions and release funds which would not have occurred in normal times (Olshansky, et al, 2006). Similarly, sociologists describe the phenomenon whereby a huge event - such as unexpected disaster - may evoke the response called "paying attention", which will lead to change within society (Catton, & Dunlap, 1980). Hence, after disaster, many people hope that disaster recovery and reconstruction can help accelerate improvement by reducing vulnerability, solving ongoing community concerns and increasing economic viability (Anderson, 1970; Berke, & Beatley 1997, Birkland 1997; Passerini, 2000).

Recognizing the particular effect of "windows of opportunity", it is widely regarded that both communities and local governments must be thoughtful and deliberate in order to maximize the opportunities provided by disasters for improving the city (Olshansky, 2010). However, even though a disaster will always captures people's attention, many scholars also have noticed that actually this attention span usually will be very short, lasting at most for several months following the disaster (Olshansky, 2006; Schwab, et al., 1998**)**. Hence, if the plan for recovery takes too long, the opportunity will become ineffective to achieve significant change and improvement for the community.

2.1.3 Main Challenges to achieve successful post-disaster recovery and reconstruction

2.1.3.1 Challenge to overcome the nature of "fog of war"

It is widely recognized that the beginning of disaster response and short-term recovery process always has had the "fog of war" characteristic (Tierney, Lindell,& Perry, 2001; Olshansky, Johnson, & Topping,

2008). After a disaster, information is usually insufficient or even incorrect, and few people would have a calm head during such an intense time. Hence, it is extremely difficult for both individuals and governmental agencies to have a comprehensive and exact recognition of the whole situation and make proper decisions in a short time. Besides, some other scholars point out that since the whole environment after disaster is typically unstable and fickle, it is very common that the decision environment changes while the strategy is being implemented or even while the strategy is still being devised (Burby, 1998). These changes furthermore aggravate the complexity of the decision-making process. Meanwhile, it is pointed out that this "fog of war" may last for a long time - covering each recovery and reconstruction phase (Olshansky, et al., 2008).

2.1.3.2 Challenge to achieve balance between speed and quality

Many scholars point out that every post-disaster recovery and reconstruction manifests tension between speed and deliberation, and they regard the balance between speed and quality as one of the measures of a successful recovery process (Olshansky, 2006; Burby, 1998). First of all, speed of recovery is very important to "keep businesses alive, rebuild infrastructure, and provide temporary and permanent housing for disaster victims" (Olshansky, 2006, p148). The urgency of residents to get back to their homes, the pressure of business owners to return to normalcy, and the substantial inflow of capital all push for rapid reconstruction (Berke, & Campanella, 2006). Meanwhile, as stated above, windows of opportunity for change and improvement after disaster typically do not stay open for long. The decisions of post-disaster recovery and reconstruction, especially at the first phase, always have to be made quickly and usually with little time for reconsideration before new problems urgently demand attention **(**Schwab, et al., 1998**).**

However, due to the "fog of war" nature of disaster recovery and reconstruction, serious tensions and conflicts may be generated (Olshansky, et al., 2008). Meanwhile, since the process of disaster recovery and reconstruction is preceded in sequence and the phases usually greatly overlap, the actions taken at the earlier stage may influence the following reconstruction stages significantly. It is a challenge, therefore, to ensure that actions made during the short-term period of an emergency are decided upon in consideration of longer-term development requirements (Jha, Barenstein, Phelps, Pittet, & Sena, 2010).

Long-term disaster recovery and reconstruction requires comprehensive and strategic consideration of the post-disaster damage situation and needs time to establish a recovery plan. After the disaster, people have to fit a great many reconstruction activities into a short period of time (Burby, 1998). As noted by Kates, Colten, Laska, and Leatherman (2006), "cities and regions seeking to reconstruct after a disaster seem to simultaneously pursue goals to rapidly recover the familiar and aspire to reconstruct in safer, better, and sometimes more equitable ways" (p, 14,656). The balance between speed and deliberation, i.e., "meeting

the time-sensitive needs of housing and economic recovery, while also maximizing the opportunity for community betterment" (Olshansky, et al., 2006, p372), is crucial in achieving a successful disaster recovery.

2.1.3.3 Challenge of achieving socio-economic improvement and equity

The disaster-affected area could use disaster recovery and reconstruction to achieve societal improvements rather than solely restoring the previous condition. Meanwhile, socio-economic improvements may be much more difficult and complicated to be achieved than the improvement of physical environment. Passerini (2000) summarized several case studies of the socio-economic changes of disasters toward communities. The study shows that whether the community could obtain, economic and social improvement is largely dependent on local conditions. However, she still pointed out that the communities after disasters are not usually improved in the long run. On the unlikely chance that change occurs, it rarely lasts, and "social stratification, economic viability, political motivation and structural features all tend to return to pre-disaster conditions" (Passerini, 2000, p67).

Moreover, many researchers have noticed that disaster recovery and reconstruction may furthermore aggravate the issue of inequality since there are always winners and losers in disasters (Dynes, 1989; Olshansky et al., 2008). It is widely recognized that disasters may bring different impacts toward different groups, as reconstruction usually benefits the socially powerful at the expense of the less powerful (Dynes, 1989). Hence, it is indicated in many cases that a lot of individual households or businesses are taken advantage of and not able to recover, even after the whole urban system had been restored (Alesch, 2007).

2.1.4 Disaster recovery and reconstruction planning

Post-disaster recovery and reconstruction is about planning and managing processes to rebuild homes, livelihoods, and the economy as effectively, equitably, quickly, safely and sustainably as possible (Olshansky, 2010; Schwab, et al., 1998**).** Long-term reconstruction success stems from both effective "big picture" planning and an awareness of the short-term obstacles that often thwart the achievement of larger goals (Schwab, et al., 1998). Among various definitions of planning, Fainstein's (1996) is widely accepted, defining planning as future-oriented public decision-making directed toward attaining specific goals. Sh identified three primary traits of planning: first, planning is about a vision toward the future, and it is important to set up a long-term goal which calls for efforts to realize it; second, planning has a political nature, which involves the complicated process of making decisions, and various stakeholders will get involved in this process for various purposes; thirdly, planning is about target-based actions and strategy implementation, since the vision needs to be realized in a feasible way (Fainstein, & Fainstein, 1996).

Disaster recovery and reconstruction planning includes the same traits as ordinary planning. However, since disaster recovery and reconstruction is conducted under extreme circumstances (Olshansky, 2006), it still has its own particular characteristics and requirements. For example, Schwab, et al. (1998) summarized three main contents of post-disaster recovery and reconstruction plans which are: operational strategies for the short-term recovery period; strategies for long-term reconstruction issues; and capitalization strategies that use the opportunity to implement improvements. Similarly, Berke, et al. (2006) summarized the core purposes of a disaster recovery plan as following:

> (1) offer a vision of the future after a disaster; (2) provide a direction-setting framework (strong fact base, goals, and policies) to achieve the vision; (3) inject long-range resiliency considerations into short-term recovery actions that promote redevelopment that is socially just, economically viable, environmentally compatible, and less vulnerable to hazards, and (4) represent a "big picture" of the community that is related to broader regional, state, and national disaster response and reconstruction policies. (p. 194)

Furthermore, a report released by World Bank in 2010 (Jha, Barenstein, Phelps, Pittet, & Sena, 2010) provides detailed content and guidance for disaster recovery and reconstruction planning from four major aspects which are: physical recovery (includes land use, land use zoning and building codes, physical plan), economic development, culture heritage preservation and implementation strategy (see Figure 2).

Figure 2: Guidance for disaster recovery planning contents (Jha et al, 2010)

Land use Focus primarily on land for housing and infrastructure reconstruction, but also meet other land use requirements, especially any others that have been affected by the disaster	
Housing needs assessment	How many houses have been destroyed or damaged?
	Is it safe to rebuild in the same location?
	Are there tenancy, land rights or titling issues?
	What is the housing need in different categories?
Assessment of land availability	How implement disaster risk reduction measures in available land?
	Where is available land for relocation?
	What are people's preferences in relocation?
Land allocation planning	What is government policy on land for housing reconstruction and other purposes?
	How plan the land use allocation?
	What will be the process for acquiring and allocation land?
	What will be the policy on land allocation for social and physical infrastructure?
	Is there any need for land consolidation or land pooling?
Land use zoning and building codes Should base on land use zoning system, address disaster risk reduction requirement while accommodating future growth; and include the institutional mechanism for implementation of the zoning.	

Building codes and development regulations *Output includes the design, construction and performance of buildings. The typical output is a set of building codes, or development control regulations*	What codes need to be put in place responsive to prevailing hazard risk?
	What is the architectural heritage of the region and how building codes accommodate local traditions?
	Do local building techniques need enhancement for disaster resilience?
	How will the new building codes affect housing affordability?
	How will codes apply to informal settlements of the urban and rural poor?
Guidelines and manuals	If time or institutional constraints make it unrealistic to update building codes and regulations in advance of reconstruction, an alternative is to produce advisory guidelines and manuals that can be used in reconstruction. These guidelines and manuals should be based on standards and codes from an area with similar building technologies and housing designs.
Physical plan Planning may address them collectively, or each may be dealt with separately if the situation demands it	
Road layout *Output includes road network maps and project briefs for road construction.*	What is the existing road network in the settlement or region and what is the extent of damage?
	Are new road connections required to reduce risk and enhance preparedness?
	Are new roads required to provide connectivity to housing reconstruction locations?
	Are engineering improvements required?
Plot layout *Output is a set of plot layout plans.*	While detailed design of housing layouts is a separate activity, at the planning stage it is important to prepare at least a conceptual layout of the proposed housing to ensure that the land allocation is adequate and that major issues have been addressed.
Planning for infrastructure and services *Output is a set of maps.*	This component deals with network alignments and land allocation for infrastructure services, including water supply, wastewater management, solid waste management, storm-water management, power supply and telecommunications networks.
	What are the existing systems?
	How conceptually work out improvements of existing systems that could address land-related issues?
Planning for public buildings and social infrastructure *Output is a set of maps showing locations of proposed facilities and project briefs for creating them.*	This component deals with allocation of land for facilities related to health, education, government, recreation, community development, and disaster shelters.
	What facilities existed pre-disaster and what is the extent of the damage?
	Do any facilities need relocation?
	Does it need improvement for facilities restoration?
Local economic development Assess the economic base of the settlement/region and the need for interventions in the post-disaster situation. If the disaster has destroyed livelihoods and economic diversification is a dire necessity, then the planning process needs to generate proposals for creating new job opportunities.	
Cultural heritage conservation In the planning process, conservation imperatives will find reflection in land use zoning, building regulations, and land allocation for cultural projects where relevant.	

Implementation strategy
Bring together the "big picture" of the reconstruction process, define the implementation process, estimate overall funding requirements, and assign roles, responsibilities, and tasks.

2.2 Disaster recovery and reconstruction planning and sustainable development

For long-term disaster recovery and reconstruction, sustainable development is considered as one of the most crucial goals. Affected areas need to restore their physical and socio-economic environment, but more importantly, need to develop the potential for future development and guarantee the benefits to following generations. Meanwhile, since disasters bring the particular chance for communities to rebuild and replace, the sustainable change could be both effective and timely (Passerini, 2000)

2.2.1 Concept of sustainable development

Sustainable development has been gaining popularity across various sectors in recent decades. The most widely used definition of sustainable development is presented in the report "Our Common Future" from the United Nations World Commission on Environment and Development (WCED) as "development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs" (WCED, 1987, p. 8). This definition indicates that the central goal of sustainable development is intergenerational equity, which implies fairness to coming generations (Deakin, Huovila, Rao, Sunikka, & Vreeker, 2000).

The concept of sustainable development was initially primarily focused on the environment, however, its scope began to broaden. It is widely agreed that sustainable development is to find a balance between economic development and environmental protection (Holden, Roseland, Ferguson, & Perl, 2008). The United Nations 2005 World Summit Outcome Document refers to sustainable development as economic development, social development, and environmental protection (United Nations, 2008), a concept defined as the triple bottom line approach (TBL). Equity is also considered as one crucial element of the social aspect of sustainable development (Marcuse, 1998). Similar to the concept of TBL, Campbell (1996) raised the idea of "3 E's" as the basic framework of effective sustainable planning: equity, economic development and environmental protection.

Based on the TBL and 3Es, many studies and policies have augmented the content of sustainable development. For example, Deakin et al. (2000) reported on the sustainability of urban development from the aspects of ecological integrity, equity, participation in development processes, and cultural heritage and forms of human settlement. Similarly, the Nord-Pas-de-Calais region of France set up a matrix of

guidance for regional sustainable development, which includes meeting human needs, management of environment, economic development, and participation/governance (Francois, & Larrue, 2004).

However, how to define the balanced point of sustainability between environmental protection, economic development and social equity has largely relied on their subjective value, which may vary due to multiple socio-economic and political factors. For example, Andrews (1997) states that "sustainable development is primarily symbolic rhetoric, with competing interests each redefining it to suit their own political agendas, rather than serving as an influential basis for policy development" (p. 19). Within current society, what type of, and through what means, sustainable development should be obtained still depends on local context.

2.2.2 Elements of sustainable disaster recovery

Sustainable disaster recovery involves balancing both the goals of sustainable development—environmental, economic, and social—with the goals of recovery.. For example, the desire for speed should not override the concern of environmental sustainability; livelihood opportunities should be maximized to maintain socio-economic sustainability; reconstruction work should emphasize public participation to guarantee social equity; and the governance and management of disaster reconstruction should effectively deal with the relation between short-term restoration and long-term development (Jha et al., 2010).

Among all the concepts related to sustainable disaster recovery and reconstruction, the most widely discussed one is resilient development, which means a community will "bend but not break" when struck by an extreme natural even,t with minimum loss of life and property (Burby, 1998; Schwab, et al., 1998**).** In addition, it also refers to the ability to create a greater sense of place among residents; a stronger, more diverse economy; and a more economically integrated and diverse population (Vale, & Campanella, 2005). FEMA defines hazard mitigation as "any action taken to reduce or eliminate the long-term risk to human life and property from hazards" (FEMA, 1996). Since natural disasters occur cyclically, one of the most important tasks of sustainable disaster recovery and reconstruction is to reduce the vulnerability of disaster-affected areas in order to make sure that they could have stronger capabilities to survive future disasters.

Hence, based on the contents of sustainable development and the particular characteristics of disaster recovery and reconstruction, a sustainable post-disaster recovery planning should have a comprehensive consideration of several aspects, including environmental aspects, social aspects, economic aspects, and governance. In sum, a successful disaster recovery plan should ultimately reduce the community's

vulnerability, increase its resiliency, strengthen its development ability, and ultimately achieve sustainable development.

2.2.2.1 Environmental aspect

For post-disaster recovery and reconstruction, the new pattern of land use allocation and new construction plays an important role in environmental protection and hazard mitigation. According to the report written by Jha et al. (2010), disasters always bring negative environmental impacts, ranging from damage to ecosystems to the production of vast quantities of waste. Under this circumstance, post-disaster recovery and reconstruction can either be an opportunity to address these impacts and long-standing environmental problems in the disaster location, or cause a second wave of damage. Hence, sustainable disaster recovery and reconstruction needs the careful consideration of the relation between ecological environment and human settlements.

Many studies have explored various methods to reduce the vulnerability of human settlements through land use allocation and land use regulations, as well as to minimize the negative impacts on the natural environment. For example, there is a wide agreement upon the importance of careful selection of safe sites for development based on detailed hazard assessment (Hosseini, & Hosseini, 2007; Olshansky, 2001). Some people also suggest introducing the principals of new urbanism in land use to save more open spaces and achieve environmental preservation (Boulle, Vrolijks, & Palm, 1997). Meanwhile, the land use regulations of sensitive areas are also widely emphasized, including requirements for geological or geotechnical study, site design, infrastructure design or land use restrictions (Olshansky, 2001).

Many other discussions focus on reconstruction of buildings and infrastructure. The vulnerability of human settlements toward natural hazards depends partly on physical characteristics of the buildings and infrastructure in relation to the hazard to which these structures are exposed (Boulle, et al., 1997). Among various methods, building codes are widely considered as the most effective approach for risk reduction (Olshansky, 2001). Meanwhile, it is also important to strengthen the vulnerable lifelines and infrastructure to achieve community resiliency in the future (Hosseini et al., 2007).

In general, the environmental concern for sustainable disaster recovery and reconstruction emphasizes the harmonious and interdependent relation between the physical and natural environment. On one hand, the reconstruction should fully consider its impact toward the environment; on the other hand, it should strengthen its capability to prevent damage from natural hazards in the future.

2.2.2.2 Economic and social aspect of disaster recovery

After disaster, local residents usually have a strong desire to restore pre-disaster socio-economic networks. During physical reconstruction process, people may establish a good social network to help each other to conduct the reconstruction work and have a strong desire to restore their pre-disaster economic activity; however, in many cases these links will weaken over time as the physical city recovers (Olshansky, et al., 2006). The new physical living and working environment may disrupt the pre-established network, and people may find themselves standing at a new starting line to rebuild the socio-economic network, which may need years to finish.

In addition, the extent of socio-economic recovery may vary depending on the different socio-economic and political status of specific communities and individuals. Disaster usually may aggravate the conditions of disadvantaged groups in the society. The economic disruption brought by disaster will add to the property losses already suffered by shrinking incomes and productivity (Schwab et al., 1998). Furthermore, it has been observed that households and business which are at a higher socioeconomic level and better integrated into economic and social networks, usually will more likely recover to pre-disaster levels and with faster speed than others (Olshansky et al., 2006). Many cases have demonstrated the difficulties of socio-economic recovery at all levels. For example, in the case of post-disaster recovery after the Kobe earthquake, despite the physical recovery being completely restored in three years after the disaster, evidence still shows that the socio-economic rehabilitation at individual levels and the recovery of local industries and business were not restored, which is regarded as the unfinished “20 percent recovery” (Boulle et al., 1997; UNCRD, & DMPHO, 2003). Hence, how to maintain or recreate the social-economic network after finishing physical reconstruction is regarded as a key issue for sustainable disaster recovery.

2.2.2.3 Governance / participation

(1) Governance

Governments play a significant role during the process of achieving sustainable disaster recovery and reconstruction. During disaster recovery processes, massive works of coordination, cooperation and negotiation are needed to deal with conflicts generated in the recovery and reconstruction process. In most cases, the primary task of government is to coordinate and guide the recovery and reconstruction process to achieve the long-term recovery goal, and if the governance is inappropriate, it will usually aggravate the conflicts between governments, various agencies and local citizens. At the city level, governments should set up deliberate and comprehensive recovery plans, which focus on the coordination within the multiple recovery processes, as well as on strategies to spend the government's recovery money to both benefit the public and motivate the private sectors to reinvest its recovery resources (Olshansky, 2010).

Meanwhile, it is also recognized that good governance at the city level could effectively deal with the conflict between speed and deliberate planning since local governments could strategically set priorities of different issues or areas and direct actions which are most needed (Olshansky et al., 2006).

Meanwhile, it is suggested that higher levels of government need to provide enough flexibility to the localities, in order to "facilitate recovery to the extent that they can support local organizations financially and technically and not tie their hands with excessive requirements" (Olshansky, 2010, p. 228). It is widely recognized that planning toward the future is full of uncertainties with respect to the environment, related decisions, values, and available actions or alternatives (Friend, & Jessop, 1977); and disaster recovery planning usually has to face more uncertainties than regular planning since it deals with these issues under extreme conditions, in which more things are unknown and unstable. Hence, it is important for post-disaster planning to be adaptable to the dynamic and changing conditions presented by the recovery process; and whether governments could apply their planning strategies flexibly or not at local level is crucial to determine successful planning implementation.

(2) Public participation

Many studies emphasize the importance of public participation during planning processes to achieve better planning outcomes. Public participation is particularly important in disaster-affected areas since recovery is about all groups and all aspects of society. It is recognized in many cases that after disaster, local organizations, communities and citizens know much clearer than government about their actual condition and the needs (Olshansky, 2010). Hence, it is important for disaster recovery and reconstruction to gain benefits from local knowledge and capacities (Healy, 1997), which not only could make the plan more effective, but also more consistent with local values and customs (Berke et al. 2006).

Meanwhile, public participation will also help achieve the goal of social equity, which is considered as an important element of sustainable development. After disaster, it is pointed out that the issue of inequity always becomes more urgent to be solved since damages are usually concentrated in the weakest groups with unfavorable socio-economic conditions. Hence, it is indicated that disaster reconstruction should focus on communities' needs and priorities with a specific emphasis on socially vulnerable groups (Boulle et al., 1997); and wide public participation could guarantee that all affected stakeholders could have a voice of their needs and concerns during the recovery and reconstruction process.

It is pointed out that with the pressure of speed and in the chaos of post-disaster recovery and reconstruction, it is common that government is forceful in decision-making and people are too dependent on the government (UNCRD et al., 2003). Under this circumstance, some scholars indicate that "the over-ambitious and detached planning will generally be counterproductive" (Haas et al., 1977, p.67). To

achieve an equal relationship between government and the public, many researchers on planning for sustainable disaster recovery emphasize that a community-based collaborative planning process partnering planners and citizens is crucial to achieve sustainable disaster recovery (Beatley, 1995; Blowers, 1993; Campbell, 1996; United Nations, 1992; WCED, 1987). For example, some scholars suggest that the gap between the administration's and people's perceptions can be understood by listening to the victims in the temporary shelters (Boulle et al., 1997). Some other researchers suggest that in post-disaster recovery and reconstruction planning processes, there should not be a single, hierarchical planning structure and "multiple stakeholders should get involved to solve the problems simultaneously" (Olshansky, 2006, p. 150).

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Research framework

There are different frameworks for planning evaluation. According to Berke and Conroy (2000), planning is defined as both a product of a process, and a guide for promoting the development of community in the future. Meanwhile, it is indicated that a good plan should describe the current status of a community, present a vision or direction for the community's future, and provide concrete policies that not only guide actions to achieve the vision, but also are strong enough to insure that they will be followed (Conroy, & Berke, 2004). This thesis will evaluate planning from three aspects: (1) the content of planning documents; (2) the planning process, and; (3) the implementation of planning. Figure 2 demonstrates the evaluation framework . Meanwhile, the rationale of content selection and methods of result analysis will be discussed in the following section.

Figure 3: Evaluation Framework

Evaluation Aspects	Components	Indicators	Result analysis
Content of planning documents	• General vision • Strategies to achieve the vision	• Whether include the goal of sustainable development • Environmental indicators • Economic indicators • Social Indicators	• Breadth • Depth
Planning Process	• Understanding of local situation • Public participation • Institutional cooperation	• Qualitative Evaluation based on collected information, public opinions, etc.	
Planning Implementation	• Short-term goal • Long-term goal	• Examine the gap between plan and actual implementation	

3.2 Content of planning documents

The primary goal of plan content evaluation is to examine the nature and quality of a plan. When a plan's vision aims at achieving sustainable development, the plan is successful to the degree that it is designed to become an "agent of change" for the community to realize that vision (Neuman, 1998). Accordingly, this

thesis will look at two major elements of plan contents: one is general vision, and another is the strategies to achieve that vision.

3.2.1 Evaluation of general vision

A vision statement is a formal statement of a community's desired future. Many literatures have given attention to the use of vision statements in plans to guide policy development (Olson, 1995). It is pointed out that a good visioning can refine the concept of sustainable development in the community as it becomes formalized in a vision statement and as the organizing theme of the community's comprehensive plan (Conroy, et al., 2004). However, without convincing strategies, achieving the vision will become vague and impractical. There are multiple ways to achieve a vision, and different plans have their own rationale to propose strategies and policies. In this thesis, the evaluation of general vision is based on a 5–point Likert scale listed as follows (see Figure 4).

Figure 4: Likert evaluation standard for vision evaluation

Point	Explanation
0	Did not mention sustainable development at all
1	Only mention the aspect, but not provide any explanations
2	With a little explanation and analysis
3	Have a general but simple analysis of that aspect
4	Have a general and relatively more thorough analysis of that aspect
5	Have a systematical and thorough analysis of that aspect with detailed explanation

3.2.2 Evaluation of strategies to achieve the vision

A plan which includes various strategies related to sustainable development is a starting point to achieve the general vision. To formulate a good plan, it is important to examine whether this plan has fully considered the environmental, economic and social aspects based on the principles of sustainable development; whether these strategies are complete with each of the aspect; and whether these strategies are well formulated. To organize the evaluation, using devised indicators is an effective method to closely examine the specific strategies in the plan. Indicators can be used in multiple ways, including helping on target setting, performance reviews and facilitating communication among the policymakers, experts and public (Verbruggen, & Kuik, 1991). In this thesis, indicators are applied to evaluate the overall quality of target settings in the plans and the strategies to achieve those targets.

Various institutes and organizations have developed different indicator frameworks to examine the performance of sustainability in a specific area. A successful plan can be assessed by means of progress in achieving these sustainability indicators. Among various sustainability indicator frameworks, Shen,

Ochoa, Shah, & Zhang (2010) developed an integrated indicator list named "International Urban Sustainability Indicators List (IUSIL)" , which is a comprehensive list of urban sustainability indicators composed by various international and regional organizations including United Nations (2007), the World Bank (2008), United Nation Habitat (2004), the European Foundation (1998), the European Commission on Science, Research and Development (2000), the European Commission on Energy Environment and Sustainable Development (2004). IUSIL contains 115 indicators, formed into 37 categories in order to better structure the indicators within 4 sustainable development dimensions: environmental, economic, social, and governance (Shen, et al., 2010). This thesis will primary refers to IUSIL to devise the evaluation framework. Dimensions of environmental, economic and social will be included in the evaluation of plan contents, while the dimension of governance will be integrated as one aspect of planning process.

Meanwhile, disaster planning has its particular characteristics and requirements. While IUSIL provides a comprehensive base for evaluation of sustainable development, it is important to identify which indicators in this basis are of the upmost importance in post-disaster recovery and reconstruction planning. Besides, since the primary goal of the indicators in IUSIL is to evaluate the performance of sustainability in a specific area rather than planning evaluation, it needs some adjustments when it is applied in the evaluation of plan contents. Figure 4 demonstrates the summary and explanation of all indicators in three aspects.

3.2.2.1 Environmental aspect

Settlements, land use allocation and public infrastructure reconstruction are the most important elements in post-disaster physical recovery and reconstruction planning. It is pointed out that natural disasters occur only when the built environment sits in a harmful way and when human lives are affected (Schwab, et al., 1998). For sustainable development, it is important to examine whether the plan has fully considered the environmental impacts brought by physical reconstruction and the resiliency of that area against natural hazards in the future. In this framework, six categories of indicators are selected which are: geographic balanced settlement; sustainable land use; biodiversity; natural hazard avoidance; better public infrastructure; and transportation. Within each category, all the indicators related to physical planning and construction are selected, in order to examine the relation between physical reconstruction and the natural environment.

Meanwhile, the indicators of environmental quality, including quality of ambient air and atmosphere, noise pollution, water quality, are not only determined by physical construction, but also more importantly, by the industry development pattern. Hence, the strategies for industry redevelopment, including their locations, types, and developing modes, are closely related to the performances of these

environmental indicators in the area in the future. In the environmental section of IUSIL, there is not a specific part for industrial development pattern. Accordingly, an indicator of industrial development with environmental consideration is supplemented in this framework.

3.2.2.2 Economic aspect

In post-disaster planning, it is important to achieve economic restoration at both regional and individual levels. Meanwhile, a good finance mechanism is crucial to guarantee that disaster recovery and reconstruction could be conducted with sufficient financial support. Accordingly, the major evaluation categories for the economic aspect are: the general strategies to promote economic development; strategies to strengthen microenterprises; and strategies to stimulate finance. Since the consumption and production pattern are about the economic performance rather than economic planning, they are excluded from this framework.

3.2.2.3 Social aspect

In IUSIL, the categories of social aspect are primarily focused on the residents' accessibility to various types of resources (including housing, land, civic infrastructure, transportation, education, health care, green land, and other recreational services); residents' safety (including the housing quality, capability to deal with natural hazard and disasters); culture; and social equity (including the equal accessibility toward resources and consideration for disadvantaged groups). In post-disaster recovery and reconstruction planning, the social considerations should be reflected in both physical reconstruction and policy formulations.

Figure 5: Indicator list for evaluation

Environmental aspect		
Category	**Planning elements**	**Considerations under context of disaster recovery**
E1: Geographic balanced settlement	Population growth	- Population growth in disaster-affected area need to be controlled, regarding the limits of available land
	Planned settlement	-Reconstruction methods, building designs, and choice of materials should be based on local ecological environment
E2: Sustainable land use	Balance between artificial environment and natural environment	-Need to consider the fragile of damaged eco-systems after disaster -Achieve harmonious man-nature relationship
	Proper inhabitants density	-density should consider the land capacity
	Analysis of location for new development	-Define available land after disaster based on environmental assessment of the project, avoid new risks. -New settlements should not located in areas with rich ecological resources and biodiversity
E3: Biodiversity	Management and selection of protected area	-Define area of key ecosystems after disaster

E4: Avoid Natural hazard	Define hazard prone areas	-Reconstruction should avoid hazard prone areas as much as possible -Carefully adopt proper geo-engineering methods
	Disaster prevention and mitigation instruments	-Achieve improvements based on disaster experiences
E5: Better public infrastructure	Fresh and waste Water	-Achieve improvements and increase disaster resiliency
	Energy provision	
	Waste management	
E6:Transportation systems	Transport modes	-N/A
	Energy intensity of transport	
E7: Industrial development	Development environment friendly industries	-Consider the environmental impact of industries, especially for fragile areas.
Economic Aspect		
Category	**Planning elements**	**Considerations under context of disaster recovery**
E1: Promote Economic Development	Strategy of macroeconomic development	-Restore damaged economic base -Maximize the "windows of opportunity" after disaster, create new development nodes -Make reconstruction attractive for investment and development
	Strategy of employment	- Create jobs in disaster-affected area for local residents, and call back population who leave the place - Create jobs for local disadvantaged group
	Information and communication technologies	N/A
	Research and development	N/A
	Tourism	-Establish proper commemorative places after disaster
E2: Strengthen microenterprises	Informal employment	-Provide adequate and appropriate space for home-based businesses to alleviate the issue of unemployment after disaster
E3: Stimulate Finance		-Stimulate finance resources for disaster reconstruction
Social Aspects		
Category	**Planning elements**	**Considerations under context of disaster recovery**
S1: Adequate housing	Durable structures	-Achieve improvements and increase disaster resiliency
	Right to adequate housing	-Consider titling issue and disadvantaged groups
S2: Social integration and equity	Consideration of poor households	-Promote social integration and support disadvantaged groups -Need careful integration into the fabric of the receiving settlement is essential.
S3: Culture	Culture establishments	-Respect local tradition and culture during restoration process
S4: Access to public recreation and service facilities	Enough and equal construction of public recreation facilities, green spaces, and other service facilities	N/A
S5: Energy and water access	Residents' access to electric, water and gas services	N/A
S6: Education	School aged children access	N/A

	to education	
S7: Transportation	Resident's access to transportation system	N/A

3.2.2.4 Methods of plan content evaluation

For plan content evaluation, this thesis will examine whether these planning elements are included in the plan and how they are developed. Referring to the evaluation measurement methods proposed by Laurian, Berke, Backhurst, & Crawford (2004), this thesis will evaluate the plan content from aspects of both breadth and depth.

(1) Plan breadth

Plan breadth is only to examine the completeness of the number of strategies related to sustainable development in the plans, without the consideration of the qualities of those strategies. This thesis will examine what proportion of those strategies listed in the indicator frameworks for sustainable development is included in each recovery and reconstruction plan. The evaluation indicators are set as Figure 6.

Figure 6: Evaluation indicators for bread

Point	Explanation
○	Included
√	Not included, but has similar or relevant components
—	Not included at all

The breadth is calculated as the percentage of strategies which are included or have relevant components in each plan. For example, in the environmental aspect, there are 13 elements of strategy that need to be included in the plan for sustainable development. In plan A, 5 elements are included, 6 are not included but have similar or relevant components, 2 are not included at all; hence, the breadth percentage of plan A for environmental aspect is calculated as 84%.

Policies do not always include specific techniques; or the techniques are vague, which directly reduces the overall quality of the plans (Laurian et al., 2004). Hence, besides the plan breadth, it is important to examine how well those strategies are formulated, which is referred to as "plan depth" in this thesis. For plan depth, this thesis will evaluate how many relevant policies are specifically formulated; how many policies are vaguely mentioned; and how many policies are vacant. The depth evaluation is based on a 5-point Likert scale (see Figure 7).

Figure 7: Likert evaluation standard of depth evaluation

Point	Explanation
1	Only mention the aspect, but not provide any explanations
2	With a little explanation and analysis
3	Have a general but simple analysis of that aspect
4	Have a general and relatively more thorough analysis of that aspect
5	Have a systematical and thorough analysis of that aspect with detailed explanation

Each aspect of the plans based on sustainable development principles will be evaluated through using both breadth score and depth score. The total points of each aspect are calculated by multiplying breadth percentage by average depth score. Based on the scores of breadth and depth, the plans could be evaluated by applying various criteria to analyze their components, with respect to their formulation and implementation related to sustainable development. What do the scores tell us? Is 100% likely? What is typical? What are some examples of projects receiving high and low scores?

3.2 Planning process

There are many studies focused on the evaluation of plans based on planning process. They define this category of evaluation as the performance-based approach, which focuses on the formulation process and considers the plan as a guide for future planning decisions rather than a blueprint (Alexander, & Faludi, 1989; Baer, 1997; Faludi, 1987; Hopkins, 2001; Mastop, & Faludi, 1997). It is indicated that the performance-based approach is theoretically appealing for major, long-term planning decisions that are affected by high degrees of uncertainty (Laurian, et al. 2004). By far, there has been increasing attention on the analysis of various dimensions of planning process. There are many aspects of the planning process, including public participation, resource allocation, coordination, and plan review and revision. Based on the characteristics of post-disaster recovery and reconstruction process, which is chaotic, long-term, and complicated, a good planning process should fully consider the particular situation of post-disaster planning and emphasize its key aspects. Accordingly, this thesis will closely examine three primary aspects of post-disaster planning: the understanding of the local situation, public participation, and institutional cooperation.

For the aspect of understanding of the local situation, although it is extremely difficult for people to have a complete and accurate recognition of the local condition after disaster, it is still very important to know about the chaos situation as clear as possible in order to establish a basis for the following planning work. Meanwhile, to achieve a sustainable restoration and betterment, the planning process should fully respect the local environmental, economic and social conditions. For the aspect of public participation, since

post-disaster planning is about the restoration of everything of the area and is closely related to every resident's life, it is crucial for local people to have a voice regarding what they think and expect toward their home land, as well as minimize the conflicts between multiple groups. Besides, public participation will help planners to better take advantage of local knowledge and make the plans more efficient and sustainable. For the aspect of institutional cooperation, since various players will get involved in post-disaster recovery and reconstruction, it is important to have an effective and efficient coordination and cooperation mechanism in the planning process. Based on the collected information, this thesis will have a qualitative evaluation and analysis of these three aspects of post-disaster planning process in the case study.

3.3 Planning outcome and implementation

Compared to studies on planning content and process, relatively low attention is paid to examine whether plan objectives and policies are actually achieved in practice. Plan implementation is defined as "the degree to which plan policies are implemented through the application of specified development techniques in planning practice, and the evaluation of plan based on plan implementation is regarded as the conformance-based approach, which focuses on planning outcomes and the linkages between plans and actual development" (Laurian et al. 2004, p. 471). A plan is considered implemented usually when development patterns adhere to its policies and meet its objectives, which assumes a direct relationship between the plan objectives and the outcomes of the plan (Wildavsky, 1973). The evaluation of planning outcome and implementation usually examines the gaps between proposed strategies and actual practice. However, while it is important to implement the planning policies, some scholars argue that since planning practice is adaptive and needs to be adjusted to ever-changing circumstances, plans need not to be strictly adhered to (Laurian et al., 2004). For post-disaster recovery and reconstruction planning, it may be relatively easier to examine the implementation of physical reconstruction than the long-term economic and social recovery for the sustainable development in the future. This thesis will examine both the short-term and the long-term planning implementation based on qualitative analysis. For the evaluation of short-term planning implementation, it will look at whether the disaster-affected areas have finished the physical reconstruction work formulated in the plans. For the long-term planning implementation, it will examine the current condition of local economic and social restoration, as well as its potential to achieve independent economic development in the future.

CHAPTER 4

INTRODUCTION OF WENCHUN EARTHQUAKE RECOVERY AND RECONSTRUCTION PLANNING

4.1 Basic information of Wenchuan earthquake, 2008

On May, 12th, 2008, a deadly earthquake of 8.0 points on the Richter scale hit Sichuan Province in the Midwest of China as a result of the tectonic collision between the Indian Plate and the Eurasian Plate (Caltech, 2008). The quake resulted in 69,222 fatal casualties, 18,176 people missing, and left 374,638 people injured (*Xinhuanet*, 2008a).

In addition to the large number of human casualties, the earthquake also resulted in severe damage to the building structures and infrastructure located on both sides of the earthquake fault line (*Xinhuanet's*, 2008b). According to the intensity map officially issued by the China Earthquake Administration, the seismic intensity level of epicenter has reached 11 Lie Du[3]. Based on varying degrees of damage, China divides the disaster-affected areas into several categories and it is reported that the most seriously affected area covers approximately 26,000 kilometers[2]. Meanwhile, 15 million buildings were destroyed in the quake. The direct economic loss of Wenchuan earthquake is estimated at 125.6 billion dollars (845.1 billion RMB)[4], in which infrastructure loss accounts to 21.9 percent of the total loss (the State Council, 2008a).

4.2 Wenchuan earthquake recovery and reconstruction planning process

4.2.1 Emergency response

On the night of the quake, the Chinese government quickly responded to the disaster. The State Council organized an emergency meeting and established a Wenchuan Earthquake Rescue and Relief Headquarter (WERRH) with Premier Wen Jiabao as the chief head to coordinate the disaster rescue and relief efforts (Zhao, 2008).

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[3] The China Seismic Intensity Scale (CSIS) is a national standard in the People's Republic of China used to measure seismic intensity. The scale was initially formalized by the China Earthquake Administration (CEA) in 1980, therefore often referred to by its original title as "China Seismic Intensity Scale (1980)". The standard was set for revision not long before the 2008 Sichuan earthquake.
Revision of "China Seismic Intensity Scale" started". China Earthquake Administration. 1999-04-26. Retrieved 2008-09-12.

[4] Based on RMB currency in 2008, this thesis will adopt currency with 1 dollar = 6.8 RMB

Meanwhile, the National Committee for Disaster Reduction (CNCDR) [5] started up the first-level emergent response of disaster relief. At the same time, leaders of the departments in the State Council, military units, armed police units, local party committees and local governments formed eight fighting groups, including the rescue team, monitoring group, medical group, life arrangement group, infrastructure group, production recovery group, security group and publicity group. Within 5 hours, the Emergency Response and Rescue team was in the Wenchuan area. By midnight, there were over 20,000 army and police personnel in the disaster area. A team of over 220 medical personnel was sent to Duijiangyan City. Meanwhile, the Ministry of Civil Affairs (MCA)[6] and Ministry of Finance[7] immediately released 2.9 million dollars (20 million RMB) of emergency funds to Sichuan Province as a national natural disaster emergency living allowance (*Renminnet's*, 2008).

4.2.2 Hierarchical recovery planning process

At the same time of disaster emergency response, the central government of China also soon started to set up post-disaster recovery and reconstruction plans. On May 21st 2008, the State Council decided to establish a Disaster Recovery and Reconstruction Fund. The Ministry of Finance arranged 10.3 billion dollars (70 billion RMB) into this fund. On May 23rd, upon the decision made by WERRH, the National Development and Reform Commission (NDRC)[8], the Ministry of Housing and Urban-Rural Development (MHURD) [9], and the disaster-affected provinces established a special team on reconstruction planning. On May 27, the State Council came up to the decision to establish a paired-assistant mechanism as the basic mode for Wenchuan post-earthquake recovery and reconstruction. Each disaster-affected province was to be paired with a non-affected province or area, usually one with a relatively higher economic

[5]National Committee for Disaster Reduction (CNCDR) is led by Ministry of Civil Affairs of China, which is primarily in charge of the formulation of national hazard mitigation strategies and policies, as well as the coordination of their implementations. CNCDR is led by Vice- Premier Hui, Lingyu.
(Retrieve from http://baike.baidu.com/view/3239691.htm)

[6] The Ministry of Civil Affairs of the People's Republic of China is a ministry under the jurisdiction of the State Council of the People's Republic of China, responsible for social and administrative affairs.

[7] The Ministry of Finance of the People's Republic of China is the national executive agency of the Central People's Government which administers macroeconomic policies and the national annual budget. It also handles fiscal policy, economic regulations and government expenditure for the state.

[8] The National Development and Reform Commission (NDRC) is a macroeconomic management agency under the Chinese State Council, which has broad administrative and planning control over the Chinese economy. The NDRC's functions are to study and formulate policies for economic and social development, maintain the balance of economic development, and to guide restructuring of China's economic system.
(Retrieved from: http://en.ndrc.gov.cn/)

[9] The Ministry of Housing and Urban-Rural Development is a ministry of the government of the People's Republic of China which provides housing and regulates the state construction activities in the country. It was formerly known as the Ministry of Construction.

development level, in order to gather the nation-wide effort to accelerate the speed of reconstruction (*Renminnet's*, 2008).

4.2.2.1 Wenchuan Earthquake Disaster Recovery and Reconstruction Act

On June 8th, 2008, the State Council enacted the Wenchuan Earthquake Disaster Recovery and Reconstruction Act (WEDRRA), which provides the legal basis and financing policies to various government entities within and outside the quake-hit region to conduct recovery and reconstruction actions (the State Council, 2008b). This is the first time that the Chinese government set up an act for a specific natural disaster. In this act, China set up the requirements for 9 specific contents of recovery and reconstruction planning, including the overall plan and urban system plan, village construction plan, urban and rural housing construction plan, infrastructure construction plan, public service construction plan, location of productive forces and industry adjustment plan, market service system plan, hazard mitigation and ecological restoration plan, and land use plan.

4.2.2.2 Plan of Paired-Assistance for Wenchuan Earthquake Post-disaster Recovery and Reconstruction

According to WEDRRA, the State Council released the Plan of Paired-Assistance for Wenchuan Earthquake Post-disaster Recovery and Reconstruction (PPAWEPRR) on June 18th 2008. This plan paired affected localities with unaffected regions of China to assist with reconstruction. 24 earthquake-affected counties (18 of which are located in Sichuan province) were partnered with 19 unaffected provinces across China. In the report released by the World Bank, it is pointed out that in this model a city with better institutional capacity can help paired areas by compensating temporarily for any deficiencies in staffing or local capacity caused by the disaster itself (Jha, et al., 2010). According to PPAWEPRR, the assisting provinces shall offer assistance with no less than 1 percent of their last ordinary budget revenues. Meanwhile, each province was given tasks with timeframes for their completion. These relationships were to last for at least 3 years after the earthquake (the State Council, 2008c). The tasks for the assisting provinces cover various aspects of both short-term and long-term disaster restoration and reconstruction. The major tasks are: (1) to provide services including planning, building design, professional consultation, engineering construction and supervision; (2) to reconstruct and restore urban and rural residential houses; (3) to reconstruct and restore public service facilities, including schools, hospitals, radio and television, sports and recreation, and social welfare; (4) to reconstruct and restore infrastructure facilities including roads, water supply and drainage, gas supply, sewage, and waste management; (5) to reconstruct and

restore agricultural infrastructure; (6) to provide support for mechanical equipment and instruments; building materials; teachers and medical workers; training programs; schools and nurseries; and agricultural technology.; (7) based on the market operation mechanism, to encourage local enterprises to invest in industries and construct commercial service facilities, and participate in profit-making infrastructure construction; (8) other contents based on negotiation (the State Council, 2008c).

The strategy of paired-assistance is creative to alleviate the financing problem and difficulties of large-scale recovery and reconstruction to a great extent. However, since this strategy was formulated soon after the earthquake without any previous experiences of implementation in a post-disaster recovery and reconstruction process, many issues emerged which need further consideration. For example, due to the different GDP levels of the assisting areas, the funds for paired areas may vary greatly based on the minimum requirement of 1 percent of the previous year's ordinary budget revenues as financial support. Figure 8 shows that the total finance provided by assisting areas ranges from 2.88 to 17.24 billion dollars. Meanwhile, when comparing the economic development levels between assisting areas and paired areas, the comparison ratio of per capita GDP also varies from 1 to 7.6. Many Chinese publications have already given attention to the imbalanced financing in the different paired areas. It is pointed out that due to the different economic levels of the assisting areas, some paired areas have too much funds, while some others have to face the problem of insufficient funds (Li, Zhang, & Yu, 2009). Meanwhile, it is also mentioned that since the central government did not set up the maximum requirement for funds, some assisting areas regarded this task as one of their political achievements and competed with each other on some recovery projects, which directly leads to the inefficient allocation of funds (Li, et al, 2009). Currently the paired-assistance policy for post-disaster recovery and reconstruction is still incomplete and immature in China. Under this circumstance, in order to make sure the funds are efficiently used and the benefits of this recovery mechanism are maximized, many scholars are calling for further research on detailed regulations for its actual implementation and supervision, (Wang, 2008).

Figure 8: Paired Plan for Wenchuan Earthquake Recovery and Finance Statistics

Assisting Area	GDP 2009 (billion dollar)	Total Finance (billion dollar)	Per capita GDP of Assisting area (2008)	Paired Area	Per Capita GDP of Paired Area (2008)	Comparison Ratio
Guangdong Province	574.7	17.24	4773.82	Wenchuan Town	1876.0	2.5
Jiangsu Province	500.9	15.03	4930.00	Mianzhu City	3131.2	1.6
Shandong Province	497.1	14.91	4064.26	Beichuan Town	990.4	4.1
Zhejiang Province	335.8	10.07	5416.91	Qingchuan Town	782.9	6.9
Henan Province	284.8	8.54	2365.88	Jiangyou City	2350.1	1.0

Hebei Province	250.4	7.51	2936.32	Pingwu Town	1138.4	2.6
Liaoning Province	221.5	6.65	3771.18	An Town	1483.2	2.5
Shanghai City	219.1	6.57	9498.82	Dujiangyan City	1809.0	5.3
Hunan Province	190.1	5.70	2116.18	LiTown	1219.1	1.7
Hubei Province	188.7	5.66	2361.03	Hanyuan Town	1152.1	2.0
Fujian Province	175.7	5.27	3761.76	Pengzhou City	1335.9	2.8
Beijing City	174.5	5.23	8110.44	Shifang City	3161.5	2.6
Anhui Province	147.8	4.43	1765.74	Songpan Town	1126.6	1.6
Heilongjiang Province	121.9	3.66	2721.62	Jiange Town	961.6	2.8
Shenzhen City	120.6	3.62	11547.94	Gansu Province	1516.6	7.6
Jiangxi Province	111.6	3.35	1841.18	Xiaojin Town	807.4	2.3
Tianjin City	110.3	3.31	6618.68	Shanxi Province	2469.12	2.7
Shanxi Province	108.2	3.25	2469.12	Mao Town	917.5	2.7
Jilin Province	105.9	3.18	2815.29	Heishui Town	1085.4	2.6
Chongqing City	96.0	2.88	2147.35	Chongzhou City	2128.2	1.0

4.2.2.3 National Wenchuan Overall Planning for Post-Wenchuan Earthquake Restoration and Reconstruction

In August 12, 2008, a draft of the National Wenchuan Overall Planning for Post-Wenchuan Earthquake Restoration and Reconstruction was distributed by the National Development and Reform Commission for comment. The final plan was released in November 2008 which outlined a plan for spending over 21.5 billion dollars (146.5 billion RMB) over the next three years for recovery and reconstruction of the damaged areas. The scope of this plan covers historical, social, agricultural, psychological and economic aspects.

There are three major contents in this plan. Firstly, it set three-month targets which heavily emphasize survivor needs, as well as a comprehensive set of three-year goals to ensure that every family has a house, every household has employment, every person has social and medical care, and the infrastructure, economy and environment are all improved upon the completion of the goals. Secondly, it set up the guidelines for land use allocation planning. Based on the evaluation of ecological bearing capacity, it categorizes the land of disaster-affected areas into three types which are areas for suitable for

reconstruction; areas for appropriate reconstruction; and areas for ecological restoration. All the detailed land use allocation planning should consist of these general land use categories. Within this framework, specific decisions were delegated to provinces and municipalities. Thirdly, it set up specific guidelines of reconstruction and funding for each disaster-affected area. Particularly, it recommends that two destroyed towns—Beichuan town and Qingchuan town —should be relocated (NDRC, 2008a).

In addition, this plan particularly promoted the reuse of waste and encouraged improving the environmental sustainability of industrial plants rehabilitated after the earthquake. It raised the concept of a circular economy be applied in reconstruction. The idea was to use the resources available for reconstruction, including debris from the earthquake, as efficiently and productively as possible. It also has a focus on industrial reconstruction that could contribute to the economy in the long term and on the way in which industrial activities would be carried out once rehabilitated, seeking to reduce energy consumption; improve the conservation of water, land, and materials; and reduce their impact on the surrounding communities. It is claimed in the plan that these activities could both conserve resources and protect the environment, which, in turn, would promote the community's economic, social, and environmental development in a way that is healthier, integrated, and sustainable (NDRC, 2008a).

4.2.2.4 Sub-plans of Post-Wenchuan Earthquake Restoration and Reconstruction

Following National Wenchuan Overall Planning for Post-Wenchuan Earthquake Restoration and Reconstruction, the Wenchuan Earthquake Rescue and Relief Headquarters (WERRH) organized the related ministries and commissions under the State Council to formulate sub-plans for post-Wenchuan earthquake restoration and reconstruction. In November 7th, 2008, the State Council officially released ten Sub-plans of Post-Wenchuan Earthquake Restoration and Reconstruction which cover 10 primary aspects of reconstruction including urban system planning, village construction, urban and rural housing construction, infrastructure construction, public service facilities construction, allocation of productive forces and industrial transition, market service system establishment, hazard mitigation and prevention, ecological restoration, and land use allocation (NDRC, 2008b).

The sub-plans set up the goals that the primary work of recovery and reconstruction should be finished within three years – the land use allocation should be optimized, economic function should be restored and improved, the ability of hazard mitigation and prevention should be strengthened, the living environment should be improved, and the main infrastructure and public facilities should be restored at or beyond the pre-disaster levels. By giving the specific explanations of the requirements on various aspects of recovery and reconstruction planning, these 10 sub-plans serve as the supplementation of NWOPPWERR and give further guidance to the formulations of local plans.

4.2.2.5 Guangdong Province Paired-Assistance Plan for Restoration and Reconstruction of Wenchuan County Earthquake Affected Area

According to the PPAWEPRR, Guangdong Province is paired with Wenchuan County. In 2008 July, the government of Guangdong province released the Paired-Assistance Plan for Restoration and Reconstruction of Wenchuan County Earthquake Affected Area (GPPAPRRWCEAA). In this plan, it pairs 13 cities of Guangdong province with 13 towns of Wenchuan County (see figure 9), and furthermore explains the goals and requirements of reconstruction set by upper-level plans, in order to guide the local planning formulation.

Figure 9: Plans for Paired Planning

Paired Area	Assisting City	Institute & Reference
Caopo	Shantou	Shantou Planning and Design Institute (2008)
Gengda	Chaozhou	Chaozhou Planning and Survey Design Institute & Guangdong Architectural Science Institute (2008)
Longxi	Zhanjiang	Zhanjiang Planning and Survey Design Institute & Guangzhou Kecheng Planning and Survey Technology Company (2008)
Mianhu	Zhuhai	Zhuhai Planning and Design Institute (2008)
Sanjiang	Huizhou	Huizhou Planning and Design Institute (2008)
Shuimo	Foshan	Foshan Urban Planning and Survey Design Institute (2008)
Weizhou	Guangzhou	Guangzhou Urban Planning and Survey Design Institute (2008)
Wolong	Jieyang	Jieyang Planning and Architecture Design Studio & Shenzhen Beilinyuan Landscape and Architecture Design Institute (2008)
Xuankou	Zhongshan	Zhongshan Planning and Design Institute (2008)
Yanmen	Jiangmen	Jiangmen Urban Planning and Design Institute (2008)
Yinxing	Maoming	Maoming Planning and Design Institute & Shenzhen Urban Space Planning and Design Company (2008)
Yingxiu	Dongguan	Shanghai Tongji Urban Planning and Design Institute & Dongguan Urban Construction and Planning Institute (2008)
Keku	Zhaoqing	Zhaoqing Urban Planning and Design Institute & Shunde Planning and Design Institute Company (2008)

4.2.2.6 Wenchuan County Post-Earthquake Restoration and Reconstruction: Village and Town System Planning

Before the designated local planning institutes started to formulate the local plans for paired areas, the provincial or regional planning institutes first formulated a regional recovery and reconstruction plan for the paired area. In July, 2008, Guangdong Planning and Design Institute published the Wenchuan County Post-Earthquake Restoration and Reconstruction: Village and Town System Planning. In this plan, it set up the general arrangement of the whole county, and provided specific guidance of restoration and reconstruction planning for each town. This plan primarily aims at achieving the recovery and reconstruction at the regional level and emphasizes regional coordination. Figure 10 describes the planned urban function of each town in Wenchuan County.

Figure 10: Urban function and development orientation

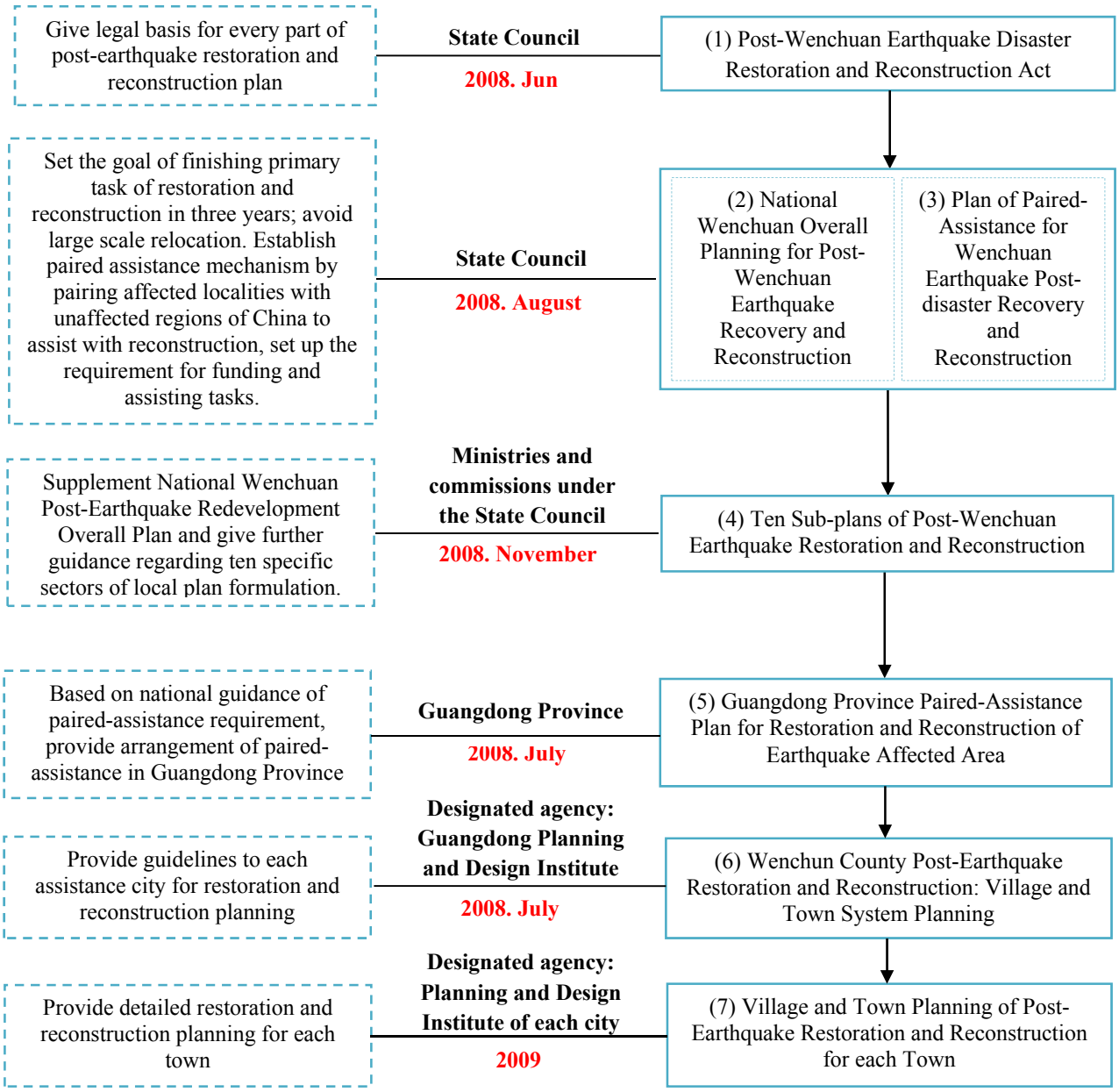
City	Urban function and development orientation
Weizhou	Provincial famous historical and cultural city, transportation center of Aba Autonomous Prefecture; political and culture center of Wenchuan County; and ecological city of Min River Valley
Yingxiu	Earthquake tourism and commemorate center; base of resort tourist center, ecological agriculture, and agriculture tourism; County public transportation commute center; County service center for electricity and water; regional tourism service center; County key construction town
Shuimo	Service town with systematic education, ecological living and trade.
Xuankou	key industrial and tourist town of Wenchuan County
Mianzhu	One of the key towns of Wenchuan County; develop characteristic agriculture, processing industry of agro-product, and tourism.
Wolong	World class research center for panda protection; ecological town with ecological tourism as leading industry
Keku	Agricultural cluster around Wenchuan County; Small town with leading industries of vegetable and fruit agriculture, mining and tourist service; County center of culture and folk custom of Qiang race
Yanmen	Key area of east Wenchuan County; develop tourism and characteristic agriculture; tourist town with Qiang culture
Gengda	Ordinary town with main functions of ecological protection, ecological tourism and eco-agriculture
Longxi	New town with minority race characteristic; develop resource processing industry; water conservancy, transportation, and tourism
Caopo	Ordinary ecological agriculture town of Wenchuan County; develop ecological tourism and village tourism; One part of provincial ecological tourism and natural protection area

Yinxing	New town with minority race characteristic; develop resource processing industry; water conservancy, transportation, and tourism
Sanjiang	Tourist town with development of rural ecological tourism and recreation.

4.2.2.7 Village and Town Planning of Post-Earthquake Restoration and Reconstruction for each Town

Based on the arrangement of the Paired-Assistance Plan for Restoration and Reconstruction of Wenchuan County Earthquake Affected Area, as well as the guidance in the series of plans from central to provincial level, each assisting city was to designate local planning and design institutes to formulate the detailed recovery and reconstruction plan for paired areas. Generally, all the local plans were finished within three months. The following section of this thesis will give the detailed evaluation and discussion of local plans. Figure 11 shows the summary of the hierarchical structure of Wenchuan post-earthquake recovery and reconstruction planning. Wenchuan County was the most disaster-affected area in this earthquake. 13 towns were seriously affected during the disaster, among which, Yingxiun was defined as the epicenter and was completely destroyed. According to the report sent by Guangdong Planning and Design Institute (2008), in Wenchuan County, 15,941 people were dead, 7,295 were missing, and 34,583 were injured. Up to 145,600 people were affected by the earthquake. Housing, transportation, public service facilities and infrastructure facilities were all seriously damaged. Meanwhile, the ecological environment was greatly harmed. It is estimated that the direct economic loss has been up to 9.5 billion dollars (64.6 billion RMB).

Figure 11: Summary of structure of Wenchuan post-earthquake recovery and reconstruction planning



CHAPTER 5

EVALUATION OF WENCHUAN COUNTY RECOVERY AND RECONSTRUCTION PLANNING

5.1 Evaluation of content of planning documents

5.1.1 Vision for sustainable development

Using the plan evaluation system described in Chapter3, the average points per plan is only 2.3 (see Figure 12). The concept of sustainable development in 13 local plans is primarily presented from two aspects: one is the need to deal with the relation between short-term and long-term development; another one is the need to deal with the relation between environmental, economic and social development. Although all the plans set sustainable development as one of the planning principles, few of them further explain it in details in the subsequent planning content. Visions in most plans still primarily focused on short-term restoration due to the urgent task of completing the restoration within 3 years. The vision for long-term sustainable development is reflected more as a slogan rather than a practical goal in the plans.

Figure 12: Evaluation Result of Vision for Sustainable Development

City	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	Average
Point (5 scale)	4	5	3	1	2	3	2	2	2	1	2	1	2	**2.3**

C1 – Weizhou, C2 – Yingxiu, C3 – Longxi, C4 – Caopo, C5 – Yinxing, C6 – Sanjiang, C7 – Gengda, C8 – Mianzhu, C9 – Yanmen, C10 – Xuankou, C11 – Wolong, C12 – Keku, C13 – Shuimo

5.1.2 Strategies to achieve the vision

5.1.2.1 Environmental aspect

(1) E1: Geographic balanced settlement

Generally, the strategies about geographic balanced settlement are widely included in the plans. All the plans include the strategies of planned settlement; and except Xuankou, all the other 12 plans have the content of population growth.

For depth evaluation, strategies for planned settlement have the highest analysis depth which is 4.8. After the earthquake, how to plan settlements, which not only could meet the people's urgent needs for housing but also have fewest environmental impacts toward the fragile ecological system, is thoroughly discussed in all the plans.

However the depth for population growth analysis is only 2.3. Weizhou and Yingxiu have a systematic analysis of population growth forecasting according to the actual post-earthquake condition, by comparing the results from different forecasting models. Longxi, Yinxing, Yanmen and Shuimo have different forecasting models of population growth for both short-term and long-term periods; meanwhile, with the consideration of the impact brought by the earthquake, they adjust the previous population growth rate to adapt to the new situation. However, the plans of all the other towns simply forecast the population growth based on the previous population growth rate without paying particular attention to the actual post-earthquake conditions.

(2) E2: Sustainable land use

The breadth analysis shows that all the plans have considered the balance between the artificial and natural environment, as well as the proper inhabitant density. However, few plans include the analysis of location for new development. Except Weizhou, Yingxiu, Yanmen, Wolong, Keku and Shuimo, all the other plans do not reserve land for development in the future.

For depth evaluation, most plans well consider the balance between the artificial and natural environment, which has 3.5 points for average analysis depth. The related strategies are presented in both urban structure planning and detailed land use allocation. Since the ecosystem of Wenchuan County was seriously damaged after the disaster, all the planning for physical reconstructions are based on the land suitability analysis.

After the earthquake, because the available land in Wenchuan County was largely reduced; most plans develop many strategies to fully utilize the limited available land to meet residents' demand for housing and other urban functions. In urban structure planning, large concentrated available land is usually developed into central commercial, official and other public facilities area; while most of the rest of scattered available land are planned into small residential areas to accommodate small groups of villagers. Although there is a general consideration of man-nature relation in the physical reconstruction planning, the analysis is most concentrated on the availability of land rather than the land capacity. For example, most plans have identified the large available lands located in the plain area in the river valley; however, whether the land development intensity is proper or not still lacks further considerations in the plans.

For the planning of proper inhabitant density, all plans set up the density of land use allocation strictly based on the requirements of Wenchuan County Post-Earthquake Restoration and Reconstruction: Village and Town System Planning, which regulates the proper density for both towns and villages in various scales based on their impacts on the natural environment and their different requirements for land use

efficiency. It is regulated in the plan that, for central towns, the average population density should be 80m^2 / person for short-term period and 85m^2 / person for long-term period; for secondary towns, population density should be 80-90m^2 / person; and for third-level towns, it should up to 90-100m^2 / person (Guangdong Planning and Design Institute, 2008) . All the plans aim at accommodating all the populations. If the available land in town is insufficient, some people will be relocated to other areas. However, after the earthquake, the land suitability and capacity may vary based on different extent of damage. Under this circumstance, whether all the residential land could be developed with the required density or not still needs specific discussion in the local plans.

Analysis for potential land development in the long-term is seriously lacking. Most of the plans aim at fully using existing available land. For those plans which include the aspect of land for new development, most of them simply point out the location of reserved land for further development without specifying the rationale of the choice of location.

(3) E3: Biodiversity

Generally, only six plans include aspects related to biodiversity. The average depth point for management and selection of protected areas is only 1.8. The earthquake brought great damage to the whole ecological system of Wenchuan County. Under this circumstance, the systematic restoration of biodiversity is a long-term task with great difficulties. NWOPPWERR requires that every local plan should identify the areas for ecological restoration in the disaster-affected area based on the land evaluation. However, very few local plans particularly point out the areas for ecosystem restoration. For biodiversity, the primary goal of most plans is to stabilize the hillsides and prevent landslides in the future.

(4) E4: Avoid natural hazard

Upon the requirement of NWOPPWERR, all the plans have emphasis on avoiding natural hazards in the future and consequently, the average depth of analysis is up to 4.8. In Wenchuan County many villages were previously located on the hillsides with high slope which were already not suitable for settlements even before the disaster. After the disaster, due to the large scale of landslides, the issue of limited land is greatly worsened. Based on land evaluation, most plans provide detailed information of the location of hazard prone areas; and all the land use allocation plans have carefully considered the land suitability to make sure the reconstruction is not located in hazardous areas.

Meanwhile, it is required in the upper-level plans that all the plans for local reconstruction should include disaster mitigation. Except Xuankou, all the other 12 plans have an independent section of disaster prevention and mitigation to enhance resiliency in the future. However, the contents for disaster

prevention and mitigation are mostly focused on detailed physical construction for short-term emergency response, which includes the planning of evacuation area and passageway; improvement of the construction of critical public services facilities and "lifeline" infrastructures; flood control planning; and fire plan. A comprehensive and complete plan for both short-term and long term hazard mitigation is missing in all the plans.

(5) E5: Better public infrastructure

Restoration and reconstruction of public infrastructure is one of the primary tasks of Wenchuan post-earthquake recovery planning. On one hand, the reconstruction is able to offer the chances for the disaster-affected area to upgrade infrastructure services and solve previous problems; on the other hand, due to the fragile ecological environment, the large scale reconstruction of public infrastructure needs particular attention to their impacts toward the natural environment.

All the plans pay particular attention to water supply and waste water management. Since most disaster-affected villages are located in hillside areas, before the earthquake, many of them had already faced the difficulties to find fresh water resources and meet the water demand for both agriculture and living usage. After the earthquake, many fresh water resources are destroyed and water has become an emergent issue which needs to be solved immediately. In all the local plans, fresh water supply and waste water treatment is regarded as the most important part in the section of infrastructure reconstruction. In addition, most plans are considering solving the previous problem by searching for new water resources, building waterworks and upgrading waste water treatment establishment.

Wenchuan County is located by the Min River, which is the upper reach of the Yangtze River. Consequently, the reconstruction of water infrastructure also needs particular attention to its impacts on the local water environment. All the plans mention the importance of protection of water resources; however, most plans lack specific strategies of water resource protection, as well as analysis of the environmental impacts brought by infrastructure reconstruction.

For energy use, most plans include energy supply as one part within the section of infrastructure reconstruction. Gas supply and electricity network are the major contents of energy supply planning. Before the earthquake, most villages in rural areas burned firewood for energy use. After the earthquake, due to the great loss of forest and the strict requirement of environmental protection, most plans change the energy supply from traditional wood-burning to natural gas provision. Meanwhile, some plans also recommend the usage of marsh gas for energy in rural areas. However, the average depth of energy use

analysis is only 2.5, since most plans only mention general guidance for clean energy supply while few detailed strategies are included.

For waste generation and management, because the population in most towns is small and scattered, the primary strategy for rubbish management is to gather and transfer rubbish to large waste disposal plants in the city. Most plans include the general planning of rubbish gathering locations and rubbish transfer stations in the area. However, the content of waste generation and management is mostly focused on residential garbage and there is no specific arrangement for industrial waste management.

(6) E6: Transportation energy intensity

All transportation plans are about road reconstruction and residents' accessibility. No plan mentions the energy intensity of the transportation system.

(7) E7: Industrial development with environmental concerns

According to the development orientation set in the upper-level plans, most plans formulate industrial development strategies with full considerations of their environmental impacts. Because of the fragile ecological environment of Wenchuan County after the earthquake, most areas are not suitable for the development of heavy industries. All plans propose industrial transformation, through which agriculture, ecological tourism, agriculture resource processing industry, and tourism service sector are defined as the primary industries.

Figure 13: Breadth of environmental aspects included in the planning of various areas

		C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	Breadth (%)
E1	Population growth	○	○	○	○	○	○	○	○	○	—	○	○	○	**92**
	Planned settlement	○	○	○	○	○	○	○	○	○	○	○	○	○	**100**
E2	Balance between artificial and natural environment	○	○	○	○	○	○	○	○	○	○	○	○	○	**100**
	Proper inhabitants density	○	○	○	○	○	○	○	○	○	○	○	○	○	**100**
	Analysis of location for new development	○	○	—	—	—	—	—	—	○	—	√	√	○	**46**
E3	Management and selection of protected	○	○	√	—	—	—	√	—	—	—	○	—	√	**46**

	area														
E 4	Define hazard prone areas	○	○	○	○	○	○	○	○	○	○	○	○	○	**100**
	Disaster prevention and mitigation instruments	○	○	○	○	○	○	○	○	○	○	○	○	○	**100**
E 5	Fresh and waste Water	○	○	○	○	○	○	○	○	○	○	○	○	○	**100**
	Energy use	○	○	○	—	○	○	○	—	○	—	○	○	○	**77**
	Waste generation and management	○	○	—	○	—	○	○	○	○	○	○	○	○	**85**
E 6	Energy intensity of transport	—	—	—	—	—	—	—	—	—	—	—	—	—	**0**
E 7	Industrial development with environmental concerns	√	√	√	√	√	√	○	√	√	√	○	√	√	**100**
Breadth (%)		**92**	**92**	**77**	**69**	**69**	**77**	**85**	**69**	**85**	**62**	**92**	**77**	**92**	

Note: ○ – Included; √ - Not included, but has similar or relevant components; — Not included at all;
E1 – GeoGraphic balanced settlement; E2 – Sustainable land use, E3 – Biodiversity, E4 – Avoid natural hazard, E5 – Better public infrastructure, E6 – Transportation, E7 – Industrial development, C1 – Weizhou, C2 – Yingxiu, C3 – Longxi, C4 – Caopo, C5 – Yinxing, C6 – Sanjiang, C7 – Gengda, C8 – Mianzhu, C9 – Yanmen, C10 – Xuankou, C11 – Wolong, C12 – Keku, C13 – Shuimo

Figure 14: Rank of environmental aspect with widest concerns by areas

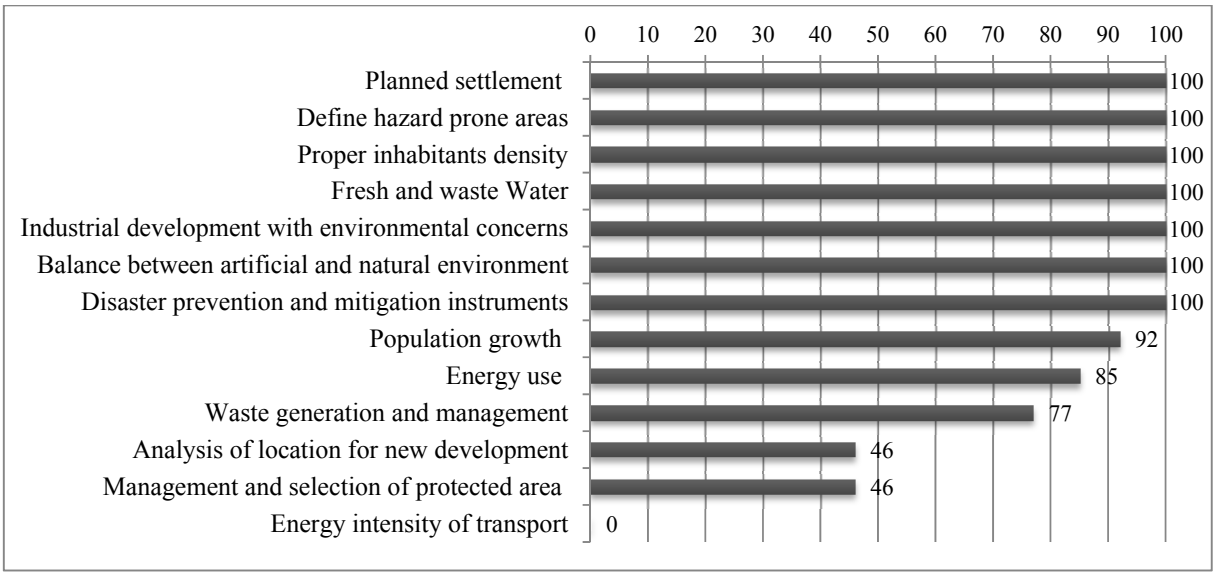
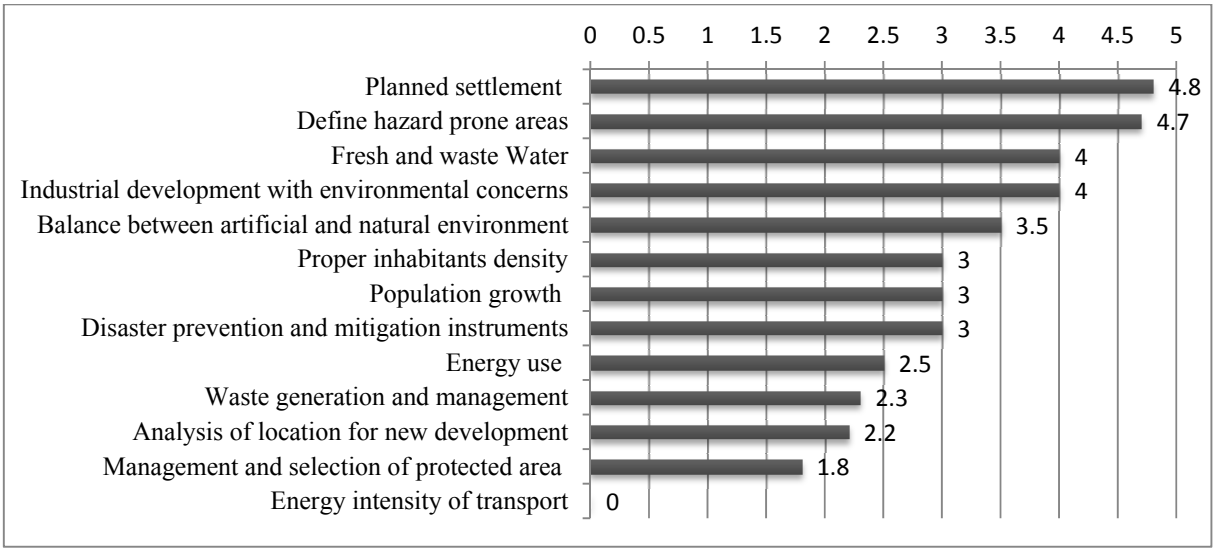


Figure 15: Depth of environmental aspects included in the planning of various areas

		C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	Average Depth
E 1	population growth	5	5	4	3	4	2	2	2	4	—	2	2	4	**3**
	planned settlement	5	5	5	5	5	5	5	5	5	3	5	5	5	**4.8**
E 2	Balance between artificial and natural environment	4	4	4	4	4	3	4	3	3	1	4	4	4	**3.5**
	Proper inhabitants density	3	3	3	3	3	3	3	3	3	3	3	3	3	**3**
	Analysis of location for new development	4	4	—	—	—	—	—	—	3	—	4	3	2	**2.2**
E 3	Management and selection of protected area	4	4	4	—	—	—	4	—	—	—	5	—	3	**1.8**
E 4	Define hazard prone areas	5	5	4	4	4	5	4	5	5	5	5	5	5	**4.7**
	Disaster prevention and mitigation instruments	4	5	3	3	3	3	3	3	3	—	3	3	3	**3**
E 5	Fresh and waste Water	4	4	4	4	4	4	4	4	4	4	4	4	4	**4**
	Energy use	3	3	4	3	3	3	2	—	2	—	3	3	3	**2.5**
	Waste generation and management	3	3	—	—	—	3	3	3	3	3	3	3	3	**2.3**
E 6	Energy intensity of transport	—	—	—	—	—	—	—	—	—	—	—	—	—	—
E 7	Industrial development with environmental concerns	4	4	4	4	4	4	4	4	4	4	4	4	4	**4**
Average Depth		**3.8**	**3.8**	**3.1**	**2.6**	**2.7**	**2.8**	**3.7**	**2.5**	**3.1**	**1.8**	**3.5**	**3.1**	**3.4**	

Note: E1 – GeoGraphic balanced settlement; E2 – Sustainable land use, E3 – Biodiversity, E4 – Avoid natural hazard, E5 – Better public infrastructure, E6 – Transportation, E7 – Industrial development, C1 – Weizhou, C2 – Yingxiu, C3 – Longxi, C4 – Caopo, C5 – Yinxing, C6 – Sanjiang, C7 – Gengda, C8 – Mianzhu, C9 – Yanmen, C10 – Xuankou, C11 – Wolong, C12 – Keku, C13 – Shuimo

Figure 16: Ranks of depths of environmental aspects



(8) Summary

The evaluation indicates that most of the physical restoration and reconstruction have environmental concerns. Since the ecological environment is very fragile after the disaster, all the plans noticed the relation between the artificial environment (including residential settlements, infrastructure construction, and industrial establishment) and the natural environment. All land use allocation is based on suitability evaluation of land, and the construction will avoid hazard prone areas. Meanwhile, with the experience of the earthquake, all the plans are required to include an independent section of disaster prevention and mitigation.

However, the environmental concerns for long-term environment development are much less included in the plans. Since available land is very limited after the earthquake, most plans focus on identifying suitable land and planning the land use allocation. Very few plans considered the reservation of land for further development. Also few of them provide specific strategies for protected areas or ecological restoration areas.

5.1.2.2 Economic aspect

(1) E1: Promote general economic development

All the plans have provided general guidance and strategies for local microeconomic development. Through SWOT analysis, they noticed the great difficulties of resuming the previous economic structure after the earthquake due to the great loss of farmland and seriously damaged ecological environment.

Despite the disadvantages, all the plans have noticed the "windows of opportunity" of finding a new economic development engine to achieve industry transition. For macroeconomic development, all the plans set up the goals of economic recovery and growth within both short-term and long-term periods. The short-term goal is to use three years to resume or even go beyond the pre-disaster economic level and income level. The long-term goal is to keep or even exceed the pre-disaster economic growth rate after three years restoration. According to the economic strategies set by the upper-level plans, each local plan lists basic guidance for local industry development and plans land use allocation correspondingly. However, except for stating the opportunities under the post-disaster situation and setting the general guidance for industrial development, the detailed feasibility analysis for selected industries, as well as the specific strategies of how to fully take advantage of these particular opportunities after the earthquake is largely missing in all the plans. Consequently, the average analysis depth of microeconomic development is only 2.5.

Strategies for employment are combined with strategies for macroeconomic development in most plans. It is the goal in all the plans that every person should be guaranteed a job after disaster. Due to the unfavorable geographic location and fragile ecological environment, the previous economic level of Wenchuan County was very low and most people relied on family farming for employment. However, after the disaster the available farmland is greatly reduced, which has become a serious issue for local people to find new employment opportunities. Although all the plans point out the importance of employment strategies, the average analysis depth of employment strategy is only 1.9. It is predicted that the development of new sectors – such as modern agriculture, processing industry of agro-product, and service industries - could bring new employments to local residents. However, there are few specific analyses about how many jobs will be created, whether local people are capable to get the new jobs, and other related aspects of the employment issue. Except for the plan of Yingxiu, which includes the calculation of employment growth in the future, other plans only set up a general vision for employment without further explanation.

Among all the economic strategies, tourism is most emphasized in all the plans and it has relative higher average analysis depth than other economic development strategies. Tourism and tourist services are regarded as the biggest stimulation of economic growth and employment creation after earthquake. Many plans include detailed physical design of tourist attractions and travel route organization. However, as the same as the analysis of microeconomic development, it lacks systematic analysis of the rationale and feasibility of tourism development based on various local conditions.

For information and communication technologies, most plans only include infrastructure planning for telephone network, television tower, broadcasting instruments, and post office construction to meet

residents' basic needs for communication. Planning for the establishment of internet service networks and development of other modern information and communication technologies are seldom mentioned in all the plans.

Strategies of research development are largely missing in all the plans. Only Weizhou mentions in one sentence that it is important and necessary to replace traditional agriculture with modern agriculture by developing new agricultural technology.

(2) E2: Strengthen small and microenterprises

In the section of tourism development in all 13 plans, most plans encourage local individual households to develop "Joyous Farmer's House" as a way to achieve self-employment. The development of informal employment is regarded as an effective way to solve the employment problems of those farmers who lost farmland after the earthquake. It is assumed that along with the general development of tourism, local households will have the great opportunity to develop small tourism service business. However, most plans only mention the general guidance of informal employment development, while the specific policies are missing in most plans.

(3) E3: Finance

Wenchuan post-earthquake recovery and reconstruction has its particular financing mechanism. All the plans point out the primary finance sources for both short-term and long-term recovery and development. For short-term physical reconstruction, the finance sources are primarily from governmental financial support, donations, and money collected by individual households. For long-term development, most plans emphasize the importance of developing markets to attract financial investment. However, the specific strategies for long-term finance are lacking in the plans.

Figure 17: Breadth of economic aspects included in the planning of various areas

		C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	Breadth (%)
E1	Strategy of macroeconomic development	○	○	○	○	○	○	○	○	○	○	○	○	○	**100**
	Strategy of employment	○	○	○	√	—	√	√	√	—	—	○	√	√	**77**
	Information and communication technologies	○	○	○	—	○	○	○	○	○	○	○	○	○	**92**
	Research and development	√	—	—	—	—	—	—	—	—	—	—	—	—	**8**
	Tourism	○	○	○	○	√	○	○	○	○	—	○	√	○	**92**

E2	Informal employment	√	√	√	√	√	√	√	√	√	—	√	√	√	**92**
E3	Finance	○	○	√	○	√	○	√	○	○	√	√	√	√	**100**
Breadth (%)		**100**	**86**	**86**	**71**	**71**	**71**	**86**	**86**	**71**	**43**	**86**	**86**	**86**	

Note: E1 – Promote general economic development; E2 – Strengthen small and microenterprises, E3 – Finance, C1 – Weizhou, C2 – Yingxiu, C3 – Longxi, C4 – Caopo, C5 – Yinxing, C6 – Sanjiang, C7 – Gengda, C8 – Mianzhu, C9 – Yanmen, C10 – Xuankou, C11 – Wolong, C12 – Keku, C13 – Shuimo

Figure 18: Rank of economic aspect with most widely concerns by areas

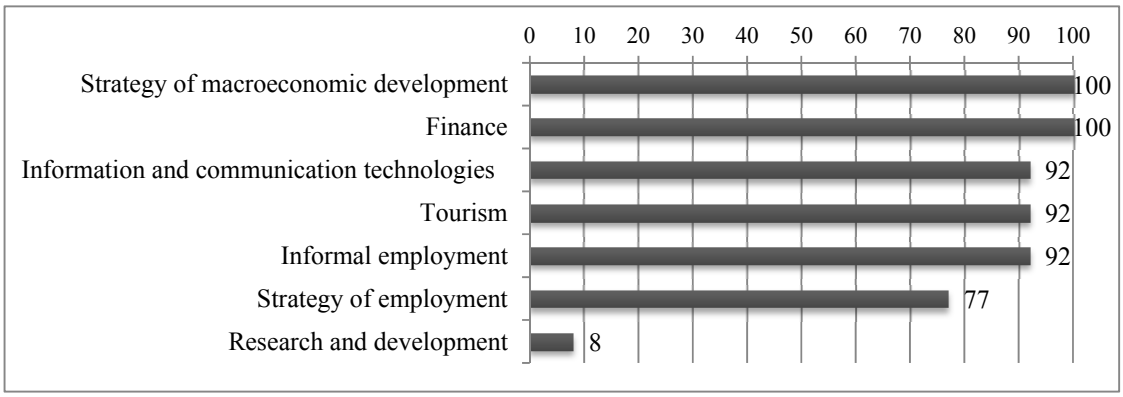
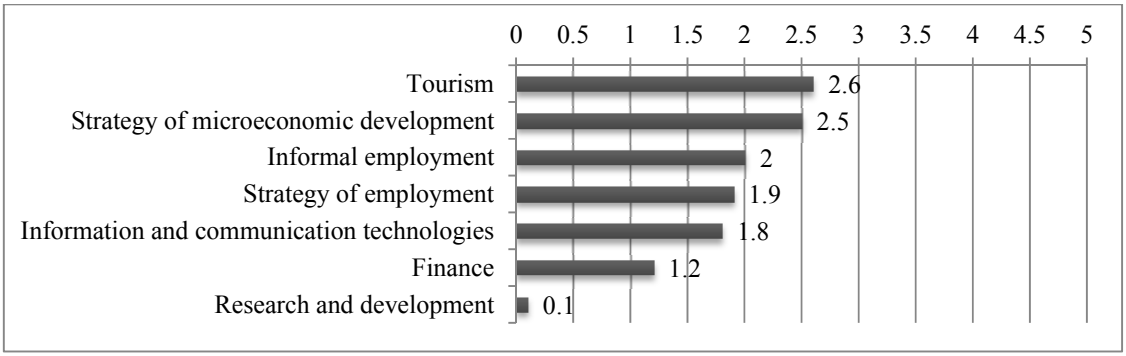


Figure 19: Depth of economic aspects included in the planning of various areas

		C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	Average Depth
E1	Strategy of macroeconomic development	3	3	3	2	2	3	3	3	2	1	3	2	3	**2.5**
	Strategy of employment	3	4	3	2	—	2	2	2	—	—	3	2	2	**1.9**
	Information and communication technologies	2	2	2	—	2	2	2	2	2	2	2	2	2	**1.8**
	Research and development	1	—	—	—	—	—	—	—	—	—	—	—	—	**0.1**
	Tourism	3	4	3	3	1	3	3	4	2	—	3	1	4	**2.6**
E2	Informal employment	2	2	2	2	2	2	2	2	2	2	2	2	2	**2**
E3	Finance	2	2	1	1	1	1	1	2	1	1	1	1	1	**1.2**
Average Depth		**2.3**	**2.4**	**2**	**1.4**	**1.1**	**1.9**	**1.9**	**2.1**	**1.3**	**0.9**	**2**	**1.4**	**2**	

Note: E1 – Promote Economic Development; E2 – Strengthen small and microenterprises, E3 – Finance, C1 – Weizhou, C2 – Yingxiu, C3 – Longxi, C4 – Caopo, C5 – Yinxing, C6 – Sanjiang, C7 – Gengda, C8 – Mianzhu, C9 – Yanmen, C10 – Xuankou, C11 – Wolong, C12 – Keku, C13 – Shuimo

Figure 20: Ranks of depths of economic aspects



(4) Summary

Generally, except for strategies of research and development, all the other economic aspects are widely discussed in the plans. However, the average analysis depth points for economic aspects are all below 3. The specific feasibility analyses of the chosen industries for long-term development are largely lacking. Except for pointing out the opportunities after earthquake and some general principals of economic development, there is no thorough discussion of how the disaster-affected areas could reach the goals of economic development and employment growth set in the plans within three years.

5.1.2.3 Social aspect

(1) S1: Adequate housing

Based on the requirement of the upper-level plans, to guarantee the living safety of all residents is considered as the most important goal in all 13 local recovery and reconstruction plans. It is emphasized that every household should have permanent and durable housing after the disaster. Wenchuan County is located in a seismic-prone area and all the buildings are required to have seismic fortification with intensity 7. However, due to the ineffective construction management before the earthquake, very few houses in Wenchuan County were able to meet the anti-seismic requirement. After the earthquake, all the local recovery and reconstruction plans require that residential houses should be constructed with anti-seismic structures. Meanwhile, some towns raised the standards of seismic fortification from intensity 7 to 8 based on the newly revised building codes set up by the Ministry of Housing and Urban – Rural Development (MHURD)[10] after the Wenchuan earthquake.

[10] The Ministry of Housing and Urban-Rural Development is a ministry of the government of the People's Republic of China which provides housing and regulates the state construction activities in the country. It was formerly known as the Ministry of Construction.

In addition, the amount of reconstructed housing is strictly based on the demand of the local population. According to the reconstruction policies set by local governments, all the housing distributed to local residents should be welfare housing with very low prices, and they cannot be sold in the housing market. The per-capita living area is also planned to meet the requirement of population density based on the planning codes. The specific arrangements of housing distribution are implemented by local governments which are not included in the recovery plans.

However, since the long-term goal of disaster recovery and reconstruction is to achieve development in the future, it is clear that the housing planning cannot only target the existing population. It is found that most local recovery plans do not include the planning of commodity housing for the growing population, as well as the consideration of potential development of the real estate industry in the future. The content of housing planning is still largely focused on short-term reconstruction.

(2) S2: Social integration and equity

Few plans specially emphasize the issue of social integration and equity. Yingxiu emphasizes the re-establishment of social networks to help people restore their economic life as soon as possible, especially for disadvantaged groups. Sanjiang mentions the disparity of farmers' income before the earthquake due to the difference of farmland qualities; and it is pointed out that the income inequity may increase after the earthquake, and the economic condition of disadvantaged groups may suffer much greater than other groups. Although these two plans mention that the lives of disadvantaged groups should be assured after the disaster, the average analysis depth is only 1.2 since few specific policies are actually formulated to address the issue.

(3) S3: Culture

Most disaster-affected areas in Wenchuan County are located in ethnic minority areas, which have a high percentage of the Qiang minority population. Most local recovery and reconstruction plans point out that both the land use allocation pattern and architecture styles should respect the local ethnic culture, especially for housing reconstruction. It is indicated in many plans that the housing reconstruction should respect the ethnic minority's opinion, and preserve their original living patterns as much as possible.

As one part of the economic strategy for tourism development, most plans include the content of restoration and preservation of local historical and cultural sites; as well as planning for new cultural tourism attractions. For example, Weizhou decided to promote the King Yu Culture through a series of new constructions including sculptures, museums, and squares. However, the analysis depths of these strategies are different between various plans. For those towns which are set as the key areas for cultural

tourism development in the upper-level plans, their strategy analyses are more thorough and complete than other towns.

(4) S4: Access to public facilities

All plans have an independent section of public facilities reconstruction. It is their goal to make sure all people could have access to various types of public services including green land, recreational facilities, medical services and other facilities. Since after the earthquake most public facilities were destroyed, all the plans consider the reconstruction as a chance to upgrade the public facilities as well as achieving a more balanced and accessible allocation than before.

(5) S5: Energy and water access

As with public facilities, infrastructure reconstruction and betterment is one of the primary sectors in all local recovery and reconstruction plans, which aim at achieving the goal that all the residents will have adequate access to gas, electricity and water after reconstruction.

(6) S6: Education

All the plans include allocation planning for primary schools, and a few of them have planning for middle schools as well. The reconstruction of schools is to guarantee that all the school-aged children could have convenient access to education. Except for primary and middle schools, there is no planning for other levels of schooling.

(7) S7: Transportation

Restoration of the road network is one of the most important tasks of physical reconstruction. Before the disaster, Wenchuan County had already faced the problem of inaccessibility with the outer world. The unfavorable transportation condition has brought the difficulties to both residents' daily lives and local economic development. Consequently, all the local recovery and reconstruction plans aim at increasing the accessibility of local residents, especially for those villagers who live on the hilly areas. However, for the strategy analysis, all the plans are largely focused on the relation between road network construction and economic growth; while seldom mentioning daily transportation planning for individual households.

Figure 21: Breadth of social aspects included in the planning of various areas

		C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	Breadth (%)
S1	Durable structures	○	○	○	○	○	○	○	○	○	√	○	○	○	100

	Right to adequate housing	○	○	○	○	○	○	○	○	○	○	○	○	○	**100**
S2	Consideration of poor households	—	○	—	—	—	√	√	—	—	—	—	○	○	**38**
S3	Culture establishments	○	○	○	○	—	—	√	○	○	—	—	○	√	**69**
S4	Access to public recreation and service facilities	○	○	○	○	○	○	○	○	○	○	○	○	○	**100**
S5	Access to electric, water and gas services	○	○	○	○	○	○	○	○	○	○	○	○	○	**100**
S6	School aged children access to education	○	○	○	○	○	○	○	○	○	○	○	○	○	**100**
S7	Access to Transportation	○	○	○	○	○	○	○	○	○	○	○	○	○	**100**
	Breadth (%)	**88**	**100**	**88**	**88**	**75**	**88**	**100**	**88**	**88**	**75**	**75**	**100**	**100**	

Note: S1 – Adequate housing; S2 – Social integration and equity, S3– Culture, S4 – Access to public facilities, S5 – Energy and water access, S6 – Education, S7 – Transportation, C1 – Weizhou, C2 – Yingxiu, C3 – Longxi, C4 – Caopo, C5 – Yinxing, C6 – Sanjiang, C7 – Gengda, C8 – Mianzhu, C9 – Yanmen, C10 – Xuankou, C11 – Wolong, C12 – Keku, C13 – S

Figure 22: Rank of social aspect with most widely concerns by areas

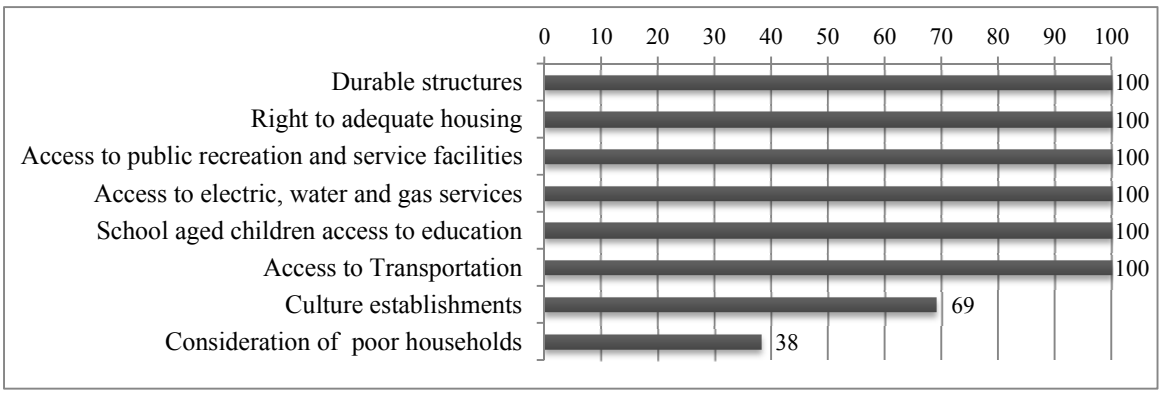


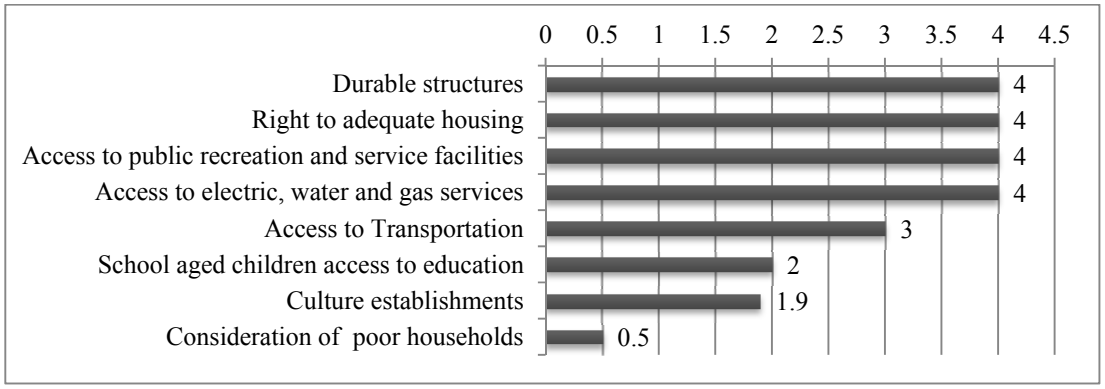
Figure 23: Depth of social aspects included in the planning of various areas

		C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	Average Depth
S1	Durable structures	4	4	4	4	4	4	4	4	4	4	4	4	4	**4**
	Right to adequate housing	4	4	4	4	4	4	4	4	4	4	4	4	4	**4**
S2	Consideration of poor households	—	2	—	—	—	1	1	—	—	—	—	1	1	**0.5**

S 3	Culture establishments	2	4	4	2	—	—	1	3	3	—	—	2	4	**1.9**
S 4	Access to public recreation and service facilities	4	4	4	4	4	4	4	4	4	4	4	4	4	**4**
S 5	Access to electric, water and gas services	4	4	4	4	4	4	4	4	4	4	4	4	4	**4**
S 6	School aged children access to education	2	2	2	2	2	2	2	2	2	2	2	2	2	**2**
S 7	Access to Transportation	3	3	3	3	3	3	3	3	3	3	3	3	3	**3**
Average Depth		**2.9**	**3.4**	**3.1**	**2.9**	**2.6**	**2.8**	**2.9**	**3**	**3**	**2.6**	**2.6**	**3**	**3.3**	

Note: S1 – Adequate housing; S2 – Social integration and equity, S3– Culture, S4 – Access to public facilities, S5 – Energy and water access, S6 – Education, S7 – Transportation, C1 – Weizhou, C2 – Yingxiu, C3 – Longxi, C4 – Caopo, C5 – Yinxing, C6 – Sanjiang, C7 – Gengda, C8 – Mianzhu, C9 – Yanmen, C10 – Xuankou, C11 – Wolong, C12 – Keku, C13 – Shuimo

Figure 24: Ranks of depths of social aspects



(8) Summary

Most planning strategies related to social aspects involve physical reconstruction. Based on the requirements in upper-level plans, all the local plans need to guarantee that every person in the disaster-affected area will have good and equal access to housing, public services, civic facilities and education. It is hoped that the living quality of all the residents will be improved after the reconstruction. However, it is well known that physical reconstruction is only the first step of a complete social recovery. The strategies of restoration of social networks and the practical methods of improving the social equity of disadvantaged groups still need to be developed in the local plans.

5.1.2.4 Summary of planning contents

Figure 25: Summary of the performance of each plan

		C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	Average
Vision Statement		4.0	5.0	3.0	1.0	2.0	3.0	2.0	2.0	2.0	1.0	2.0	1.0	2.0	**2.3**
Strategy	Environ-mental	3.5	3.5	2.4	1.8	1.9	2.2	3.1	1.7	2.6	1.1	3.2	2.4	3.1	**2.5**
	Econo-mic	2.3	2.1	1.7	1.0	0.8	1.3	1.6	1.8	0.9	0.4	1.7	1.2	1.7	**1.4**
	Social	2.6	2.6	2.7	2.6	2.0	2.5	2.9	2.6	2.6	2.0	2.0	3.0	3.3	**2.6**
	Total point	**8.4**	**8.2**	**6.8**	**5.4**	**4.7**	**6.0**	**7.6**	**6.1**	**6.1**	**3.5**	**6.9**	**6.6**	**8.1**	

Note: C1 – Weizhou, C2 – Yingxiu, C3 – Longxi, C4 – Caopo, C5 – Yinxing, C6 – Sanjiang, C7 – Gengda, C8 – Mianzhu, C9 – Yanmen, C10 – Xuankou, C11 – Wolong, C12 – Keku, C13 – Shuimo

By multiplying the depth point by the breadth point, Figure 22 shows the comprehensive point for each aspect of each town's local plan. It is shown that within the 5 point scale, all the evaluation results are generally below 3. For the vision statement, the concept of sustainable development is not put into a crucial place. For specific contents of plans, the strategies related to environmental and social sustainability have relatively higher average comprehensive points than the strategies for economic sustainability.

Low comprehensive scores are primarily the result of low depth scores. The previous analysis results indicate that most plans have covered a wide aspects related to sustainable development; however, the specific and detailed strategy analyses are generally not thorough and complete enough.

When examining the comprehensive performance of each town's local plan, it is found that the performances of the local plans are largely related to their urban functions and status in the upper-level plans (see Figure 26 & 27). Wenchuan County Post-Earthquake Restoration and Reconstruction: Village and Town System Planning, formulated by Guangdong Planning & Design Institute, provide a general rank of the 13 towns of Wenchuan County based on their economic and political status within the region. For example, Weizhou, Yingxiu and Shuimo are given the highest statuses within the 13 towns, with Weizhou planned as the executive center of Wenchuan County; Yingxiu - the epicenter- as the key tourist destination; and Shuimo as the model town of landscape and tourism development. The evaluation results show that Weizhou, Yingxiu, and Shuimo have the highest total and average scores, indicating that the towns' status will affect the quality of its recovery and reconstruction plan. This is primarily due to the reason that the towns which play a more important role in Wenchuan County are usually paired with cities which have a higher economic level, and their plans are formulated by better institutes than the others.

Figure 26: Total scores of evaluation result of 13 towns –ranked by economic and political status

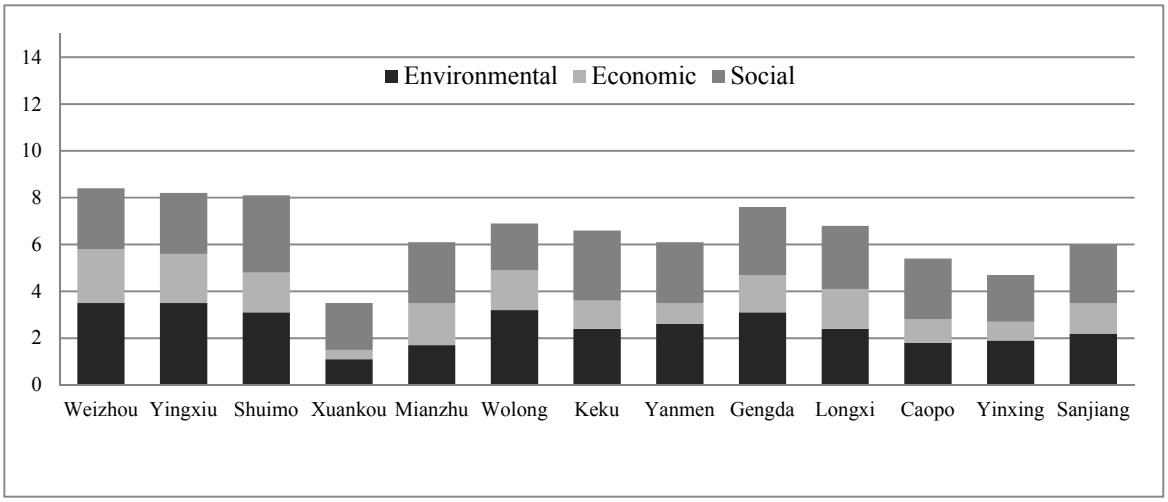
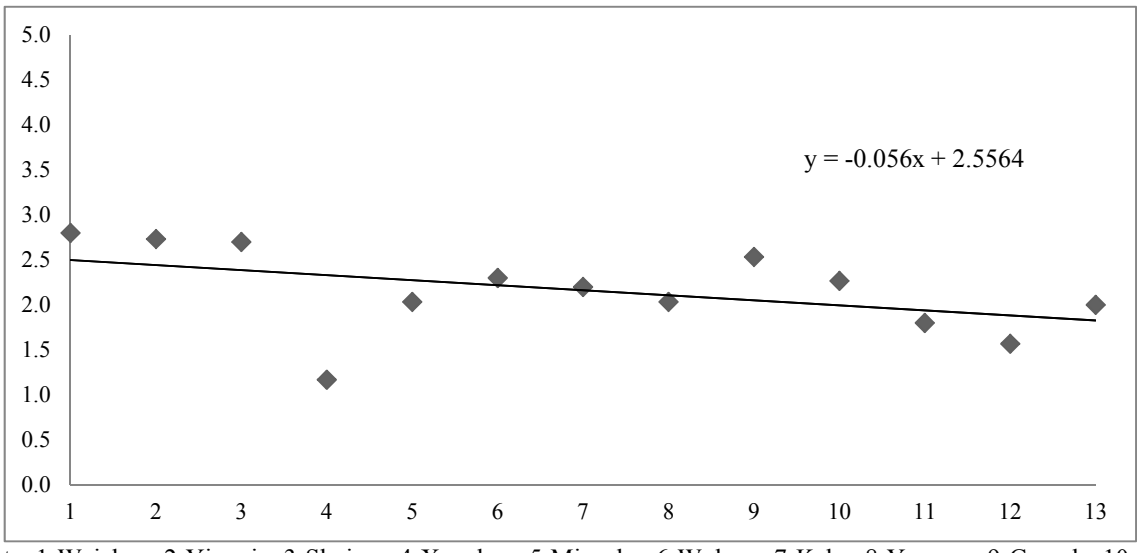


Figure 27: Average scores of evaluation result of 13 towns –ranked by economic and political status



Note: 1-Weizhou, 2-Yingxiu, 3-Shuimo, 4-Xuankou, 5-Mianzhu, 6-Wolong, 7-Keku, 8-Yanmen, 9-Gengda, 10-Longxi, 11-Caopo, 12-Yinxing, 13-Sanjiang

5.2 Planning process

5.2.1 Understanding the local situation

5.2.1.1 Land evaluation

The first task of post-disaster recovery and reconstruction planning is to evaluate the land damage condition and environmental capacity as the basis for land use allocation planning. After the Wenchuan earthquake, the evaluation was conducted exclusively using government data sources and satellite imagery. With technological assistance, the central government soon identified the whole disaster-affected area into three categories which are: areas for reconstruction, areas for appropriate reconstruction with some specific treatments, and areas for ecological restoration and not suitable for construction. This land evaluation result is included in the National Wenchuan Post-earthquake Redevelopment Overall Plan (NWPROP). Meanwhile, some other geological survey institutes also conducted land evaluation at the provincial level in more detail. All these evaluations are considered as general guidance for local planning institutes to formulate land use allocation in an environmentally sustainable way.

However, it is also recognized that the land evaluation proposed by NWPROP and other geological survey institutes are still not specific enough for local planning institutes to learn about the detailed local land damage condition. Meanwhile, the reconstruction work needs specific evaluation of every housing and public facility to determine its reconstruction strategy. Qiu, Baoxing, the Vice Minister of the Ministry of Construction pointed out in July 2008 that the local planning institutes cannot over-rely on the land evaluation reports sent out by upper-level plans and other geological survey institutes, since it would be time consuming to wait for the evaluation results, and also the evaluation results may be not accurate and complete enough. Under this circumstance, every local planning institute should at the same time send its own survey team to the paired area to identify the detailed damage condition. According to the requirement, all the local recovery and reconstruction plans in Wenchuan County included a comprehensive evaluation report which covers the evaluation of ecological systems, land allocation, building and public facilities damage, infrastructure damage, and transportation. The first investigation usually lasted for two to three weeks in July, 2008. Meanwhile, during the planning process, some institutes also returned to the disaster-affected area several times for re-evaluation when necessary.

5.2.1.2 Understanding the change before and after the disaster

The first section of all the local recovery and reconstruction plans is the general comparison of the conditions of the earthquake-affected areas between pre-disaster and post-disaster. The comparison includes territorial condition, economic development, population change, urban construction, infrastructure and transportation. The general understanding of the change after earthquake could provide planners the basic idea of how recovery and reconstruction planning could fully consider the local condition before the disaster and deal with the dramatically changed situation after the disaster.

Comparing the situation before and after the earthquake, most plans point out that the primary challenges of successful recovery and reconstruction are the serious ecological damage, weak resiliency toward

natural hazards in the future, and great loss of farmland; as well as the great economic loss due to the damage of local industries. Meanwhile, the weak local economic basis before the disaster furthermore aggravates the difficulties of its recovery and reconstruction. But all the plans also point out the opportunities of potential development after the disaster. The opportunities not only include the large amount of financial assistance from outside resources and the chance for tourism development (identified as "eyeball economy"), but also the opportunities to solve previous problems by upgrading all the public services and infrastructure and achieving industrial transition from the previous extensive mode into an intensive and sustainable mode.

However, except Yingxiu, which mentions the damage to social networks after the disaster, all the other plans only focus on the physical and economic aspects. Some plans mention the change of population composition after the disaster and their potential impact toward local economic development in the future. Generally, the understanding of social issues after the earthquake is largely limited in most plans.

5.2.1.3 Usage of previous planning

Since the local condition has been greatly changed by the earthquake, most previous local plans cannot be considered for guidance of the formulation of recovery and reconstruction plans. Meanwhile, except for some large towns, such as. Weizhou and Yingxiu, that had formulated local plans before the earthquake, other towns and villages did not systematically formulate local plans, and so most of the planning information was missing during the earthquake. Despite this situation, most plans still try to search for the previous planning documents as much as possible during the recovery and reconstruction planning process as a way to learn about the local governments' vision for development before the disaster.

5.2.2 Public participation

It is required in the upper-level plans that the local reconstruction plans should fully respect the local residents' opinions. Thus, all the plan institutes conducted interviews and surveys to collect local opinions. The plans showed that most local residents did have a voice of their thoughts and suggestions about reconstruction; however, their opinions were not necessarily adopted in the plans, and how the recovery and reconstruction plans were formulated was still largely decided by the professional planners and governments at various levels. Consequently, public participation in Wenchuan County recovery and reconstruction planning only occurred before the planning formulation instead of the whole process. In addition, the participation mechanism was only a one-sided information collection rather than active two-sided communication and negotiation. Generally, public participation in Wenchuan County recovery and

reconstruction planning was very limited in both length and depth. The percentage of local people who got involved in the surveys and interviews also vary among the local plans.

5.2.2.1 Opinion collection process

During the surveys and interviews, citizens or villagers were encouraged to publicize their opinions toward two primary aspects of reconstruction: (1) their attitudes toward relocation and methods of housing reconstruction; and (2) their expectation or thoughts about employment and their economic life in the future. The results show that most villagers hoped to stay at their original place and were not willing to remove to other places. For example, in the survey of Weizhou Recovery and Reconstruction Plan formulated by the Guangzhou Urban Planning and Survey Design Institute (2008), it shows that 47.8 percent of responses in Weizhou hope their houses be reconstructed completely at the same place, while as high as 85.2 percent want to move back to their original place if the area is confirmed safe and various preferential policies are able to be viably implemented. However, some households, especially the poor ones, regarded this reconstruction process as a chance to escape their previous disadvantaged situation, and they preferred other areas for better ecological environment, transportation accessibility and economic development. For the mode of reconstruction, most of the local residents hoped that governments can take charge of the reconstruction completely; while a small proportion of the residents wanted to reconstruct their housing by themselves with governmental subsidies. Those farmers who lost farmland during the earthquake hoped they could be relocated to urban areas. Regarding living patterns, most plans indicate that a large percent of villagers were able to understand the situation of limited land and were willing to change their living form from previous country-style single-family with low density into urban-style multi-story apartments with relatively higher density. However, despite the changing living pattern, they still wanted to preserve the architectural characteristics of their residential houses as much as possible.

Most families encountered serious economic damage during the earthquake and expected government financial support. It is indicated in Weizhou Recovery and Reconstruction Plan (2008) that, 30.7 percent of the local residents hoped the priority of economic restoration would be business service, while 29.1 percent were for industrial production, 25.6 percent for public production service, 10.1 percent for agriculture, and tourism service had the smallest percentage at only 4.5 percent. Some plans also indicated that different age groups had different expectations toward their employment. Generally, older people are more intent to stay in the village and engage in farming, while young people are more interested in entrepreneurship.

5.2.2.2 Consideration of public opinion

Although it is emphasized that the reconstruction work should fully respect local residents' opinions, in actual planning practice there were still many obstacles to effectively involve the public into the decision-making process. The most important issue is that the local planning formulation still primarily represents the governments' idea of reconstruction, which is basically presented in the upper-level plans and governmental documents, rather than the residents'. Although the governments' arrangement indeed fully considered local needs and tried to formulate the recovery and reconstruction as good as possible, there are still some gaps between the governmental will and the practical needs of local residents. For example, the Weizhou Recovery and Reconstruction Plan illustrates the conflict between residents' expectations and the planning goal, in that most villagers don't want to give priority to the development of tourism services, while the plan's primary economic strategy is to encourage people to develop tourism services for self-employment. The lack of effective public participation would potentially generate misunderstanding and confusion between the government and the public, which would compound the complexity of an efficient recovery and reconstruction. One survey conducted by Liu (2008) in Wenchuan County shows that at the early stage of plan formulation, local residents usually had no idea of how reconstruction would be planned; and many of them worried that their temporary housing would become permanent housing, and their farmland and original housing would be developed through requisition. Consequently, many local people strived to move back to their original places and refused to live in temporary housing. Similarly, another survey conducted by Southwest Nationality University in Wenchuan County shows that 92 percent of the responders in Wenchuan County were unsatisfied with the situation that they did not clearly understand the reconstruction strategies and policies (Zhang, Tang, Zhang, and Zhang, 2009).

There are several factors that contributed to the ineffectiveness of public participation during the Wenchuan post-disaster recovery and reconstruction process. In current China, the sense of public participation in planning is still not well developed, and the existing top-down planning system does not have a mature mechanism to involve public participation as a part of the planning process. Insufficient information resources, the lack of training, and limited ways of participation are the major problems of public participation in Wenchuan post-disaster recovery and reconstruction planning (Chen, Lei, & Liu, 2008). Mianzhu Post-earthquake Recovery and Reconstruction Plan (2008) shows that since many local people were not clear about the concept and the basic condition and requirement of reconstruction, their opinions toward reconstruction were not compatible with the actual situation, and so could not be adopted in the plans. Besides, the local residents generally could not have a transparent and effective channel to know about the reconstruction policies and ongoing information; and it is a common phenomenon that the

planners and local governors too busy with reconstruction work, while the local people were not able to offer assistance (Yang, Wang, & Zhang, 2009). In addition, some research show that the opinion of village committees [11]plays a too strong role during the opinion collection process; and the villagers cannot fully convey their opinions to the planning institutes (Yu, & Zhuang, 2009). Meanwhile, it is also found that due to the lack of effective and wide public participation, local citizens and residents of some disaster-affected areas were too dependent on the financial allocation from upper level governments and the assistance from the assisting cities while lacking initiative to get involved in the reconstruction process (Yu, et al, 2009)

5.2.3 Cooperation with professional planning institutes

5.2.3.1 Actors involved and cooperation mechanism

Urban planners, architects, landscape architects, civil engineers and geologists were the primary actors during the formulation process of Wenchuan post-earthquake recovery and reconstruction plans. The cooperation mechanism is based on both horizontal cooperation between assisting areas and paired areas; and the vertical cooperation between central and regional governments, and local governments and institutes. As shown in Figure 25 that, with the guidance provided by provincial/regional planning institutes and the technical support of local geological survey institutes, the local planning institutes - usually the best institutes of the assisting cities - were responsible for formulation of detailed recovery and reconstruction planning for the paired areas. For the planning of key areas, the local planning institutes would cooperate with other planning or design institutes/companies in different cities. For example, Dongguan is paired with Yingxiu of Wenchuan County. Since Yingxiu is the epicenter and the key town for tourism development, its recovery and reconstruction plan was formulated by Dongguan Urban Construction and Planning Institute and Shanghai Tongji Urban Planning and Design Institute collectively.

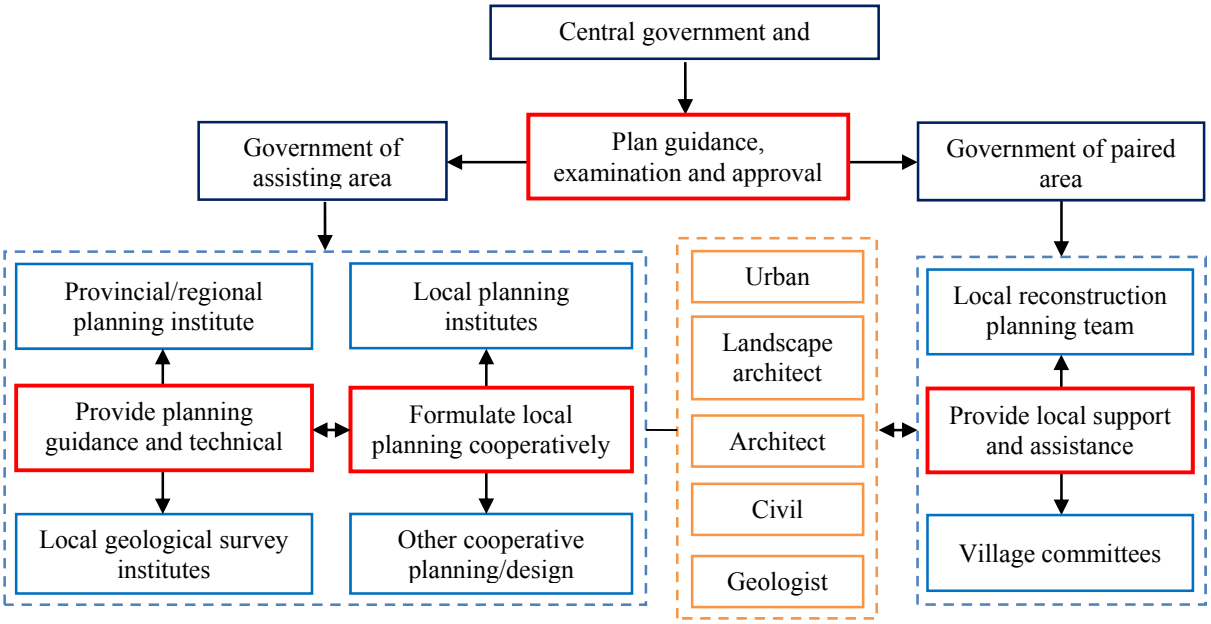
For paired areas, local governments were required to organize an assisting reconstruction group to facilitate the formulation of local recovery and reconstruction plans. The group members were usually from the local governors of various departments. Meanwhile, in rural areas, the village committees also played a role in the group as well. Since very few towns of Wenchuan County had well-developed planning institutes and local professional planners before the earthquake, the primary task of the assisting

[11]The village in China serves as a fundamental organizational unit for its rural population. In general, rural areas are organized into village committees. Village committees serve as the self-governing administration elected by villages. The election process and committee functions are based on The Organic Law of Village Committees adopted in 1998 by the National People's Congress of China.
http://baike.baidu.com/view/338465.htm)

reconstruction group was to provide required information and assistance to the planning institutes of the assisting area as well as coordinate and negotiate between the assisting areas and paired areas, rather than actually getting involved in the planning formulation process.

Governments at all levels were responsible for providing guidance to local plan formulation by sending out a series of governmental documents. Meanwhile, all the local recovery and reconstruction plans need to be approved by governments of both the assisting areas and paired areas. Similar to the planning approval system in China, once the planning institutes finish the plan formulation, the reports are sent to governments and professionals in various areas. Usually the planning institutes have to revise the plans several times based on the feedback before finally gaining official approval.

Figure 28: Cooperation mechanism of Wenchuan County earthquake recovery planning



5.2.3.2 Discussion of relationships between various actors

Although the Wenchuan post-earthquake recovery and reconstruction planning is based on a cooperative mechanism between assisting areas and paired areas, most planning decisions are still made by the authorities of assisting cities, while the local authorities and residents of the paired areas play a limited role during the entire decision-making process. At the stage of preparation for recovery and reconstruction planning, the planning institutes of assisting cities consulted local institutes assisting the reconstruction for their general opinions or expectations about the physical reconstruction and economic redevelopment in the future for reference. In rural areas, a few assisting cities found that there were

different opinions between villagers and villager committees. For example, the village committee of Yinxing hoped that the recovery and reconstruction plan could relocate the villagers to gain more available lands for urbanization, while most villagers were not willing to give up their original land for relocation (Maoming Planning and Design Institute, & Shenzhen Urban Space Planning and Design Company, 2008). Under this circumstance, planning institutes have to consider the opinions of both sides and find a balanced point.

Meanwhile, to get an approval, planning institutes need to fully consider the opinions and guidance sent by governments of both assisting cities and paired areas as well as the upper-level governments. Due to the political issues and various benefits toward different governments, the relationship between governments of assisting cities, governments of paired areas and central governments are complex and subtle during the recovery and reconstruction process, which inevitably have a significant impact toward the planning formulation. Some Chinese reports have shown that since central government only set up a minimum level of financial assistance provided by assisting cities to paired area without a maximum limit, it was common for governments of some disaster-affected areas to maximize this opportunity as much as possible and consequently set up excessively high requirements for reconstruction by assisting cities. Meanwhile, the governments of some assisting cities also took this task - which is distributed by central government - as one of their governmental achievements, and consequently the reconstruction turned out to be unnecessarily extravagant. Currently, except for some media reports, academic research about the political relationship between different governments during the Wenchuan earthquake recovery and reconstruction process and their impact toward the plan formulation is still very limited. However, the exposed issue has already indicated that within this particular paired-assisting mechanism, how to establish an effective and equitable relationship between various governments within both horizontal and vertical political frameworks can significantly influence the outcome of disaster recovery and reconstruction.

5.3 Plan implementation

5.3.1Short-term

5.3.1.1 The completion of physical reconstruction

According to the guidance of National Wenchuan Overall Planning for Post-Wenchuan Earthquake Restoration and Reconstruction, all the major physical reconstruction work should be finished within three years. It is required that the implementation of local recovery and reconstruction plans should give priority to those projects which relate to residents' livelihoods. Guangdong province set up "Ten

Livelihoods Projects" which covers the ten most important livelihoods aspects including village and urban housing, medical service, water supply, road construction, social welfare facilities, schools, culture and sport facilities, education, water supply, farm and sideline products, and hazard mitigation and prevention facilities. By December 3rd, 2009, 500 days after the earthquake, it was reported that 333 projects in "Ten Livelihoods Projects" with 0.45 billion dollars (3.1 billion RMB) investments had been completed and utilized (*Xinhuanet's*, 2009). On October 10th, 2010, the government of Guangdong province announced that by the end of September 2010, all of the 702 primary reconstruction projects of Wenchuan County had been finished, and the total paired-assisting funds had reached 1.2 dollars (8.2 billion RMB) (ABa Prefecture government office, 2010a), of which 80 percent were spent on Livelihoods Projects (ABa Prefecture government office, 2010b).

In general, the physical aspects of the local recovery and reconstruction plans have been strictly implemented within the timeline, in fact, most towns finished the task one year in advance of the deadline. Once the three-year short-term goal of physical reconstruction is reached, the assisting city would officially submit all the reconstruction projects to the government of the paired area as an announcement of the completion of the first-stage task. Figure 29 shows the submission date of each paired-area of Wenchuan County.

Figure 29: The finish date of reconstruction of paired-areas of Wenchuan County

City	Finish Date
Mianzhu	2010.7.18
Wolong	2010.5.23
Weizhou	2010.4.3
Shuimo	2010.4.2
Longxi	2010.1.26
Yanmen	2009.12.10
Sanjiang	2009.9.16
Caopo	2010.5.12
Gengda	2010.10. 10
Yinxing	2010.7.31
Xuankou	2010.3.30
Yinxiu	2010.9.23

(1) Housing reconstruction

It was the promised goal that all the households could move into new permanent housing before the Chinese Spring Festival on February 13th, 2010. By the end of November, 2009, except 872 relocated

households in Yingxiu, all the other 15,398 households of Wenchuan County had finished the housing reconstruction, and 1,296 households finished housing repairing with a total cost of 113 million dollars (769 million RMB) (Zhang, 2009). By October, 2010, it was reported that Wenchuan County had achieved the goal that "100 percent of the primary projects are completed, 100 percent of people are moved out from temporary housing into new houses", and average living space is 70 m^2 based on the planning code (ABa Prefecture government office, 2010b).

(2) Education

Due to the low construction quality, schools were most seriously damaged, which caused a large amount of fatalities during the Wenchuan earthquake. In order to guarantee all the students could go back to school for the coming fall semester in September, 2010, the government of Wenchuan County requested Guangdong province to finish school reconstruction as much as possible by the end of August 2010. It is reported that by August 27th, 2010, 16 out of 23 schools had been reconstructed (Su, & Zhou, 2010) among which Wenchuan No.1 middle school was the biggest project finished by Guangdong province in Wenchuan post-earthquake reconstruction with 39.7 million dollars (270 million RMB) investments which could accommodate 4,600 students (Song, 2009).

(3) Medical service

According to a report, Guangdong province spent 38.2 million dollars (260 million RMB) to finish the construction of medical facilities with 60,000 m^2 built area, which is 60 percent larger than the pre-earthquake level (Su et al., 2010).

(4) Water supply

Before the earthquake, Wenchuan County only had two waterworks, while all the water supply for rural areas came directly from water resources (Guangzhou Urban Planning and Survey Design Institute, 2008). Guangdong province spent 32.5 million dollar (221 million RMB) on water supply infrastructure construction, which includes 15 Waterworks and 128 kilometers of water supply pipes for towns, and 34 Waterworks and 882 kilometers pipes for rural areas. By October 2010, all the households were able to access running water. Meanwhile, considering the water demand for industrial and commercial development in the future, Guangdong Province will construct 19 irrigation projects for 6 towns in Wenchuan County (Su et al., 2010).

(5) Road construction

Guangdong province spent 84.3 million dollars (573 million RMB) to construct roads for rural areas. By October, 2010, it is reported that 100 percent of towns and villages had transportation access to the outside world, and all the roads in rural areas had been paved (Su et al., 2010).

(5) Social welfare facilities

Guangdong province invested 8.7 million (59 million RMB) to construct two large welfare centers in Wenchuan County with 13,848m^2 built area, which is 3.5 times larger than the pre-earthquake area. Meanwhile, based on the local plans, every town also has built its own social service center (Su et al., 2010).

(6) Culture and sports facilities

Guangdong province spent 7.4 million dollars (50 million RMB) on the restoration and reconstruction of broadcasting and television facilities for the whole of Wenchuan County (Su et al., 2010). Meanwhile, according to the local plans, all 13 towns have finished the construction of cultural centers and various types of activity centers. Meanwhile, except for 160, 000 m^2 of sports field area provided by 16 new build-up schools, Weizhou also has built a county stadium which could accommodate 1,500 people, and Shuimo built a sports park which could accommodate 1,000 people (Song, 2009).

(7) Rural public service facilities

Before the earthquake, public service facilities were largely lacking in Wenchuan County. Except Weizhou and Shuimo, all the rest of the 11 towns did not meet the minimum requirement of 1000m^2 built up areas of public service facilities per town (Guangdong Planning and Design Institute, 2008). In reconstruction, Guangdong Province invested 103.8 million dollars (706 million RMB) for the construction of rural public service facilities with total built area of 4,640,000 m^2 (Su et al., 2010).

(8) Farm and sideline products distribution

To stimulate the distribution of farm and sideline products, Guangdong province has spent 9.9 million dollars (67.3 million RMB) to build farm markets in all of the 13 towns. Meanwhile, a cold store which could contain 1,000 tons of products was built in Weizhou as the central service and circulation platform of Wenchuan County (Su et al., 2010).

(9) Hazard mitigation and prevention

By October, 2010, all the new constructed communities had received approval by the National Earthquake Bureau as “A Seismic Community” based on the safety evaluation. Meanwhile, based on the

local plans, Wenchuan County has built 50,252 m^2 evacuation sites in 13 towns including green areas, sport fields, and squares (Su et al., 2010).

5.3.1.2 Secondary disaster of flood and debris

Despite the high efficiency of physical reconstruction, the quick plan implementation still has exposed some problems in this process. From the 14th to 17th of August, 2010, a rainstorm hit Sichuan province and caused provincial-wide mountain floods and debris. Among all the affected areas, the earthquake-affected areas in Wenchuan County had the most serious damage during the rainstorm (Yang, 2010). On Aug 14, 2010, mudslides from Hongchungou valley, which is 500 meters away from Yingxiu, blocked the Min River and caused the river to change course (Huang, 2010). It is reported that 10 towns of Wenchuan County were affected, and Yingxiu was the most seriously damaged area during this second-hit disaster after the earthquake. The newly constructed communities were completely flooded and hit by debris. At least 31 deaths were confirmed, including technicians from Dongguan City of Guangdong Province, and the economic loss is estimated to be at least 92.6 million dollars (630 million RMB) (*Eastday's*, 2010). Many projects which were set to have been completed before Aug 26, 2010 have to be repaired or even rebuilt.

The second-hit disaster in Wenchuan County, especially in Yingxiu, is not only due to natural factors but also due to the problem of site selection for reconstruction during the planning process. Based on the land evaluation before the planning formulation, geologists reached the conclusion that the reconstruction of Yingxiu at the same place is feasible and safe; but at the same time they also pointed out some key potential geological hazardous sites around the town due to the fragmented mountain massif. Accordingly, the reconstruction adopted a series of strategies to stabilize the mountainside around the town to prevent mudslides. However, it is reported that the land evaluation neglected a serious hazardous site of Hongchungou Valley, which contains more than 3,000 thousands m^3 of loosened soil due to the earthquake, and it became the primary factor of this second-hit disaster (Qiu, & Wang, 2010). Meanwhile, some geologists also pointed out that the reconstruction plans neglected the flooding hazards of the Min River when they still rebuilt the towns by the river (Huang, 2010). After the flood and debris, Yingxiu immediately started to repair the damaged buildings and infrastructures as well as strengthen the hazard prevention measures. By 10th October, it is reported that the second-time reconstruction of Yingxiu town had already been finished. However, currently, there are still some debates about the site selection of Yingxiu. Many geologists have expressed the concerns about the Hongchungou Valley, since its unstable situation will continue being a potential hazard toward Yingxiu (Qiu, et al., 2010).

5.3.1.3 Short-term economic recovery

The economic statistics released by Sichuan Province show that within three years after the earthquake, the economic level of Wenchuan County has gradually recovered. Comparing the statistics of the period from January to August in 2010 and in 2008, the added value of state-owned industrial enterprises of Wenchuan County was 0.15 billion (1.02 billion RMB), an increase of 66.8 percent; the general budgetary revenue of local governments reached 16.8 million dollars (114 million RMB), which increased 99.9 percent; the investment in fixed assets was 1.07 billion dollars (7.3 billion RMB) with a growth rate of 2.4 percent; and the total volume of retail sales of consumption goods was 38.2 million dollars (260 million RMB), which increased 18.8 percent (Sichuan Statistics Bureau, 2010).

Besides the general economic recovery after the earthquake, the personal income of Wenchuan County also increased significantly in 2009, even exceeding the pre-earthquake level. Statistics show that in 2009, the per capita disposable income of urban residents of Wenchuan County had reached 1,870 dollars (12,780 RMB), which is 35 percent higher than that in 2007; meanwhile, the per capita net income of rural residents grew by about 20 percent from 410.3 dollars (2,790 RMB) in 2007 to 490.4 dollars (3,335 RMB) in 2009. The significant income growth in 2009 was primarily due to the job opportunities created during the reconstruction process (Lan, 2010). Since governments adopted the Relief Work Program in Wenchuan post-earthquake recovery and reconstruction, many local residents were able to get the jobs offered by local governments in infrastructure and housing reconstruction with even higher salaries than their jobs before the earthquake.

Meanwhile, the development of tourism in the disaster-affected area also has brought a significant amount of income to local residents after the earthquake. The development of tourism is the primary economic strategy set in the recovery and reconstruction plans of most towns in Wenchuan County. Within the three-year reconstruction period, Wenchuan County has restored most of the tourism infrastructure and created a series of new tourism projects. In October 22nd, 2009, Sanjiang Eco-Tourism District, which was the biggest and the first tourist resort reopening in the county after the earthquake, was reopened to the public and was regarded as a key project that would stimulate the development of the local economy (*Chinamtours's*, 2009). The statistics show that from January to August in 2010, Wenchuan County hosted 1.02 million tourists in total, which is 48.5 percent more than 2009. The total revenue of tourism has reached 63.2 million dollars (340 million RMB), which is 150 percent higher than 2009 (*Gdgov's* . 2010). On May 1st, 2010 which is the International Labor Day as well as approaching the two-year anniversary of the "5.12" Wenchuan Earthquake, 31,600 visitors went to Wenchuan County bringing 120,729 dollars (820,960 RMB) of revenue (*Globaltimes's*, 2010). In the following Spring Festival in 2011, Wenchuan County received more than 40,000 tourists, up 689 percent, with tourism revenue of 1.9

million dollars (13.2 million RMB), up 1637 percent (*Tibetculture's*, 2011). After the completion of physical reconstruction of Wenchuan County, numerous people are curious and concerned about its status. Along with the recovery of tourism sites and the construction of new tourist attractions, Wenchuan County has been able to attract a great amount of visitors in a short time since 2010.

5.3.2 Long-term recovery

5.3.2.1 Economic development

Despite the economic growth after the earthquake, many economic aspects of Wenchuan County still have not been fully restored to the pre-earthquake level. The rapid economic growth soon after the earthquake is within the post-disaster context, which may not last. With the large amount of financial assistance provided by both the central government and paired provinces, Wenchuan County was able to finish the physical reconstruction in a short time without the constraints of limited funding. Meanwhile, the large-scale reconstruction not only stimulated the development of local construction industries, building material industries and other related sectors, but also brought employment opportunities to the local residents. In addition, within the period right after the completion of reconstruction, Wenchuan County was much more attractive to people than in other time periods. All these factors combined together contributed to the rapid economic recovery after the earthquake.

However, the short-term economic recovery is only the first step for a complete post-disaster reconstruction and sustainable economic development. It is the goal in the recovery and reconstruction plans that Guangdong Province should help Wenchuan County achieve independent economic development, which is defined as from "blood transfusion" to "blood generation". Consequently, for long-term tourism development, Guangdong Province and the Wenchuan Tourism Bureau signed an agreement of "Guangdong-Wenchuan Tourism Cooperation Framework" in May, 2010. Within this framework, the tourism companies in Guangdong Province will cooperate with Wenchuan County to develop tourism products and open the market of tourist resources in Guangdong province (Xiao, 2010).

Although tourism is defined as the primary economic development engine for Wenchuan County, it is still very unclear whether it could support the local economy, especially for long-term development. Therefore, besides tourism development, Guangdong Province is also trying to seek other opportunities of economic and trade cooperation by combining the market and industrial advantages of Guangdong province with the resource advantage of Wenchuan County. It is expected that Wenchuan County can attract various enterprises to transfer from Guangdong to Wenchuan, which not only could stimulate local economic development, but also increase local employment.

Since August 2008, Guangdong Province has organized a series of economic and trade cooperation fairs to promote economic cooperation between Guangdong and Wenchuan through market-oriented approaches. The areas of cooperation cover building materials, minerals, pharmaceuticals, tourism, and other industries. By May 2009, the intended cooperative investment between enterprises of Wenchuan County and Guangdong Province had reached 0.44 billion dollars (3 billion RMB) (Guang, 2009). In April 29th, 2010, Guangdong Province and Wenchuan County further signed an agreement of the "Guangdong-Wenchuan Long-term Cooperation Framework", aiming at using three to five years to achieve active cooperation in various areas, including technical assistance, management assistance, industrial cooperation, and employment training (Yang, & Zhang, 2010). By October, 2010, Wenchuan County had restored 28 industrial projects with 98.5 million dollars (670 million RMB) investments with assistance from Guangdong province (Sun, 2010). Among all the projects, the biggest is the construction of the "Guangdong-Wenchuan Industrial Park" (GWIP) with an investment of 58.8 million dollars (400 million RMB). Due to the limited available land in Wenchuan County, GWIP is located at Jintang Town, which is 500 kilometers away from Wenchuan County.

By October, 2010, five enterprises had moved into GWIP. Despite large amounts of investments and preferential policies, the GWIP has not developed as well as expected. It is reported that without any previous experience in such industrial parks, many unexpected difficulties emerged during the negotiation and cooperation process between Yintang, Wenchuan and Guangdong. Meanwhile, GWIP set up a high requirement for enterprises to develop environmental and high-technical industries for economic development in Wenchuan County. However, the industries in Wenchuan County prior to the earthquake largely relied on natural resources and high energy consumption; consequently, it is very difficult for them to achieve an industrial transition within a short time after the earthquake, and this reduces the number of industries that can settle in the park (*Nfdaily's*, 2010). Both Guangdong Province and Wenchuan County are still exploring the proper strategy to discover a stable economic growth engine that can help to achieve the long-term economic development of Wenchuan County.

5.3.2.2 Employment problem

The Work-Relief Program has provided ample employment to local residents in Wenchuan County during the reconstruction period, including garbage disposal, sanitation and epidemic prevention, materials transportation, and installation of board houses. However, after the completion of physical reconstruction, most jobs in the Work-Relief program will soon be reduced, and many local residents are facing the problem of re-employment. A survey conducted in Wenchuan County by the Sichuan Statistics Bureau in May 2010 shows that 42.8 percent of the responders worry that they will lose their jobs within two years,

and it will be very difficult for them to get a new job primarily due to the factors of old age, low education level and disabilities (Sichuan Statistic Bureau, 2010).

To solve the problem of employment, it is estimated that through industrial cooperation, enterprises from Guangdong Province will bring employment to Wenchuan County. However, very few local residents can gain benefit from the employment provided by these enterprises. Figure 27 shows that 34 percent of the residents who have jobs are running entrepreneurial ventures, and 22.6 percent of them find employment via friends or relatives. Although it is the goal that the governments guarantee every person a job after reconstruction, this arrangement only provided 18.5 percent of the jobs. For industrial cooperation, only 0.7 percent of people could find a job provided by paired-assisting cities (Sichuan Statistic Bureau, 2010). The survey reflects the fact that despite various preferential employment policies and industrial cooperation, most of the residents still have to rely on themselves and their social network to find employment.

Figure 30: Channels for Obtaining Employment after the Earthquake, Wenchuan County

Types	Percentage
Develop own business	34.0%
Introduced though relational network	22.6%
Arranged by government	18.5%
Other	10.5%
Public exam	7.8%
Arranged by labor market and Intermediary Organizations	5.6%
Provided by Paired assisting Cities	0.7%

The primary factor causing the low employment rate in Wenchuan County is the gap between local residents' education level and the requirements of new sources of employment (Wu, & Ding, 2009). The difference between the previous industrial structure and the requirements of industrial transition after the earthquake also contribute to the gap. Since the general education level of Wenchuan County is very low, very few local residents are capable of finding jobs in high-tech industrial enterprises. Conversely, for those enterprises settling in Wenchuan County, they face the difficulties of recruiting sufficient numbers of capable local workers.

CHAPTER 6

DISCUSSION

6.1 Post-disaster recovery and reconstruction in the context of China

Many scholars have pointed out that the economic, social, and physical development factors making up the local context can influence local planning (Beatley, 1995; Berke and French, 1994; Rees, 1995). In the same way, the characteristics of Wenchuan post-earthquake reconstruction planning are closely related to the particular context of current China.

6.1.1 Political Structure and legal basis of post-disaster recovery

In Wenchuan post-earthquake recovery and reconstruction, the Chinese government has displayed a highly integrated and streamlined response which reflects the disaster relief mechanism in China under its centralized political system (Patel, 2009). The Chinese government is highly compartmentalized, with the Politburo and the Standing Committee of the Chinese Communist Party being the most influential components (Bajori, 2007). Within this basic political structure, China has taken decade-long efforts to consolidate formal decision-making authorities for disaster relief operations. Generally, China is adopting a top-down centralized mechanism for disaster relief operations, which has a unified leadership at the central level to control the overall situation; and a complex web of local authorities to implement the disaster relief strategies at the local levels based on the requirements and guidelines set up by central government.

For effective top-down management, the State Council and various Ministries have formulated a series laws, regulations, and policies as the basis for the implementation of local disaster relief works. For emergency disaster response, the Department of Disaster Relief, under the Ministry of Civil Affairs (MCA) of China, is the primary entity in charge of both the organization work of disaster relief and the formulation of related policies. In 2003, MCA established the "Working Rules of the Ministry of Civil Affairs in Response to Unexpected Natural Disasters", which is meant to guide the central government's response to domestic natural disasters. In 2007, the legal basis for emergent disaster response was consolidated by the "Emergency Response Law of the People's Republic of China (2007)", which prescribes the appropriate organizational responses to a given disaster according to its characteristics and scale, and assigns responsibilities to relevant people and institutions (Wu, 2008). Meanwhile, the central government also established some special laws regarding the most frequent and large scale disasters in China, e.g., flood and earthquake, to regulate various aspects, including hazard mitigation, short-term response and long-term recovery. For example, the *Law of Earthquake Prevention and Disaster*

Reduction released in 1998, states that: after a destructive earthquake, the State Council should establish an Earthquake Rescue and Relief Headquarters to establish a plan for emergency response; the local governments should plan and conduct disaster recovery work based on the local seismic situation and the requirement of fortification against earthquakes; meanwhile, the protection of some typical earthquake ruins and sites shall be incorporated into plans of the reconstruction of the earthquake- stricken areas for geological or historical preservation (*Law of Earthquake Prevention and Disaster Reduction, 1998*). All these regulations are considered as general guidelines for the local actions before and after disasters.

The rationale of local recovery and reconstruction planning is not only based on the guidance of upper level planning, but also to the series of newly released planning and building codes. Within the centralized political structure, China also has a top-down planning system which follows a hierarchical structure from regional to local. Usually, regional/provincial governments will first formulate a regional/provincial plan based on the overall development strategy and the coordination between different cities and towns within the region. Then, the cities and towns will formulate local plans according to their guidance. In addition, in order to achieve effective management and supervision, the Ministry of Housing and Urban-Rural Construction and Ministry of Construction has set up various kinds of planning and building codes which cover almost every aspect of urban construction from land use allocation to detailed design. Meanwhile, governments at regional and local levels also have the right to adjust the codes to the local situation when necessary. Although China has been developing planning and building codes for decades, the codes related to disaster prevention and mitigation were still largely missing until 2007, when the Ministry of Construction released "Standards for Urban Earthquake Disaster Prevention Planning". This is the first code in China which systematically provides planning and construction standards and regulations for disaster mitigation and prevention. The content covers land use allocation, infrastructure construction, buildings, hazard mitigation, earthquake evacuation, and information management. After the Wenchuan earthquake, this code was further revised and developed based on the new requirements.

6.1.2 Historical and economic context

The paired-assistance recovery and reconstruction mechanism was first considered in the 1950s, and developed in the 1960s. This mechanism was further developed via No. 52 File of the Opening and Reforming Policy in 1979 to organize the economically developed provinces and municipalities to aid their counterparts in border areas and ethnic minority areas (See Figure 28). This is the first trial by China to officially implement the Paired-Assisting (or Counterpart-Assisting Policy) nation-wide (*Xinhuanet's*, 2009).

Figure 31: Paired Assisting Plans in No. 52 File

Assisting Area	Paired Area
Beijing City	Inner Mongolia
Jiangsu Province	Guangxi Zhuang Autonomous Region, and Xinjiang Uygur Autonomous Region
Hebei Province	Guizhou Province
Shandong Province	Qinghai Province
Tianjing City	Gansu Province
Shanghai City	Yunnan Province, Ningxia Hui Autonomous Region
The Whole Nation	Xizang (Tibet) Autonomous Region

In 1993, in the "Three Gorges Dam Project Resettlement Handbook", China provided a systematic explanation of the Paired-Assisting policy. Different history, culture, location advantage, resource distribution and policy differences of each area in China created differences in economic development strategies among such areas. These differences can be seen in aggravating gaps between the eastern and the western regions of China. Meanwhile, the high occurrence of natural disasters and the associated economic loss further exacerbate unbalanced development between various regions. Under this circumstance, the Paired-Assisting Policy is considered as an effective mechanism to encourage cooperation between regions and industries, shorten regional gaps, and ultimately achieve nationwide balanced and sustainable economic development (Three Gorges Dam Construction Committee, 1993).

Usually, this policy is adopted when the central government formulates regional policies that aim at supporting the development of certain regions or industries. With the continuous practice of the Paired-Assisting Policy, its content and form are constantly enriched. Currently the Paired-Assisting Policy is primarily implemented in three modes in China: paired assistance for border areas, for major projects, and for disaster-affected areas (Wang & Dong, 2010). When implementing the policy, the central government will designate various regions or industries to form the paired relation and fully take advantage of each other's strengths. It is advocated that both sides within these paired relationships could achieve complementary advantages, mutual benefits, long-term cooperation, and common development.

6.2 Concluding discussion

Under the particular political, historical and economic context of China and the top-down planning system, the Wenchuan earthquake recovery and reconstruction has clearly reflected the advantages and disadvantages of the Chinese system.

6.2.1 Characteristics of Wenchuan post-earthquake recovery and reconstruction

6.2.1.1 The Wenchuan earthquake exposed the serious previous problems of the disaster-affected area, which furthermore increases the challenge of post-earthquake recovery and reconstruction.

Before the earthquake, the most serious problem of Wenchuan County was the fragile ecological system and limited suitable land for human settlement. Most settlements and industries are located in valleys with steep slopes and complex geological structure. Meanwhile, most industries in Wenchuan County before the earthquake largely relied on the local natural resources, which aggravate the local human-nature relationship. After the earthquake, the unstable mountains have brought a series of secondary disasters to Wenchuan County including landslide and mountain collapse. Whether the land is still suitable for human settlements becomes a primary question in the post-disaster recovery and reconstruction.

Besides the fragile ecological environment and the unfavorable geological location, inconvenient transportation access to the outside world and low-level industrial development all have impeded the development of Wenchuan County. All of these factors contributed to the great damage from the earthquake. Corresponding to the undeveloped economy of Wenchuan County is the low education level of local residents and the low living quality. As many undeveloped areas in western China, Wenchuan County also has faced the problem of loss of local young labor, because many young people choose to migrate to other cities for better employment opportunities. All these socio-economic problems were aggravated greatly after the earthquake, and increase the challenge of successful recovery and reconstruction.

6.2.1.2 The top-down political and planning system has created conditions for Wenchuan County to take greatest advantage of windows of opportunity for post-earthquake recovery reconstruction.

Wenchuan County before the earthquake was applying unsustainable development principles in both environmental and socio-economic aspects. After the earthquake, it is clear that simply restoring the previous condition is far from enough to achieve sustainable development in the future. The previous analyses have demonstrated that within the top-down political system and paired-assisting mechanism, Chinese governments have provided Wenchuan County an opportunity to solve the previous problems through both high-quality reconstruction and industrial transition. Despite the great loss and environmental damage during the earthquake, Wenchuan County has obtained many advantages after the earthquake including sufficient funds, professional assistance, technical support, and a series of preferential policies.

Chinese governments set goals for Wenchuan County to achieve both urban and rural construction improvement and economic growth. Currently most towns have already finished the physical reconstruction with high quality, and the residents' living quality has been generally improved.

Meanwhile, large amount of economic investments and industrial projects are all stimulating local economic growth. Despite these achievements, the over-emphasis on these economic opportunities may also bring problems. It is well known that the post-disaster situation has chaos and complicated characteristics. Under this circumstance, when people are ambitious to maximize the benefits brought by post-disaster opportunity, they may easily make unpractical decisions without sufficient deliberation. Furthermore, since the post-disaster reconstruction and betterment is a long-term task which needs persistent patience and efforts while the windows of opportunity are briefly open, the conflict between different time frame demands further increases the risk of making hasty and incomplete decisions. In China, the top-down political context inevitably has added many political elements into the decision-making process during the recovery and reconstruction, which makes the maximization of post-earthquake opportunity not only for local betterment, but also for achieving governments' political goals.

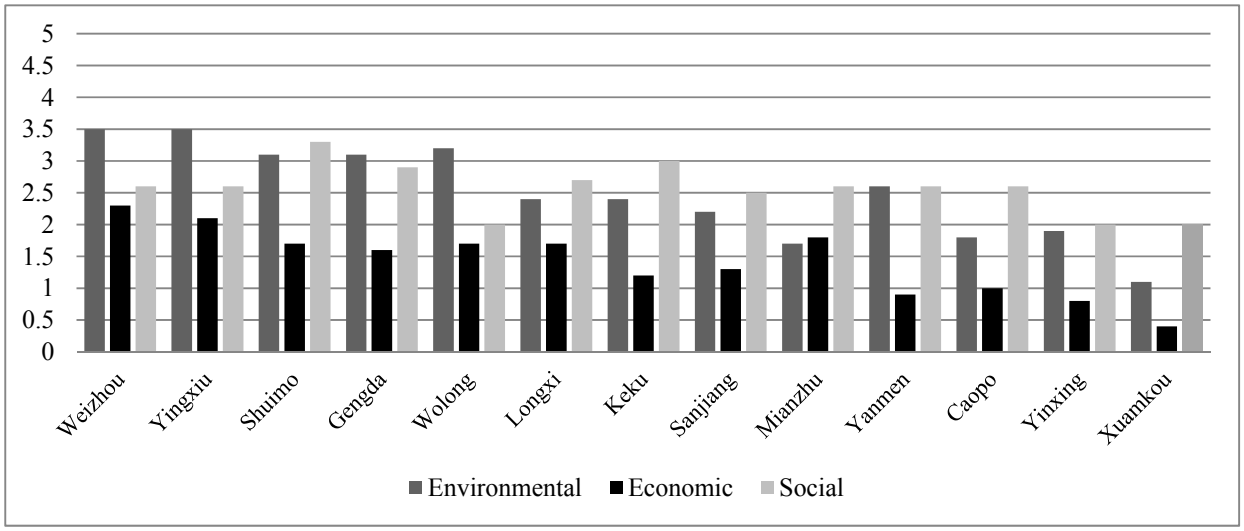
6.2.2 Short-term recovery versus Long-term development

6.2.2.1 It is important to regard long-term sustainable development as a primary goal in the vision.

The previous analysis shows that all 13 local reconstruction plans have a low performance of sustainability indicators. One of the main factors is that the primary goal of these local post-earthquake reconstruction and recovery plans is to finish the physical reconstruction within three years rather than comprehensive long-term development. When sustainable development is not regarded as the primary goal in the vision of the future, the specific plan contents may not put much emphasis on this aspect. After the earthquake, there was an urgent demand for detailed local site plans as soon as possible, and most local plans were finished within three months. According to the time-table set by the upper-level plans, the implementation of local plans should be divided into two periods. The first period is from 2008 to 2011, which aims at restoration and reconstruction; and the second period is the next five years from 2011 to 2015 which aims at achieving improvement and sustainable development. The total planning length is only eight years, and due to the limited time for planning formulation, the contents of most local plans are only able to focus on the first period. Although all the plans have mentioned the importance of the relation between short-term and long-term development as one of the planning principles, they are not fully considered in the plans.

6.2.2.2. It is important to incorporate environmental, economic, and social aspects in the plan contents with comprehensive considerations for long-term development

Figure 32: The performance of environmental, economic and social indicators



The analysis of planning contents shows that the sustainability indicators of environmental, economic and social aspects have different performance levels (see Figure 28). Generally, the environmental and social aspects have higher points than the economic ones. As stated above, the primary factor is that most planning contents are focused on short-term physical reconstruction while the contents for non-physical long-term development are very limited, the most of which are simply general guidance or suggestions without detailed analysis. Consequently, the unbalanced planning between physical and non-physical aspects directly lead to the unbalanced consideration of environmental, economic and social aspects. The environmental aspects are well developed, since the physical reconstruction needs careful consideration of the relationship between the artificial and ecological environments. Meanwhile, many social aspects related to residents' livelihoods are considered through the planning of housing, infrastructure, public facilities, and transportation. Compared to the environmental and social aspects, planning for economic development is much less related to the physical reconstruction except for construction of new sites and landscape for tourism development. Hence, the performance of economic indicators is much lower than the other aspects.

One primary factor leading to the unbalanced planning between physical and non-physical aspects is that all the local reconstruction plans are formulated by planning and design institutes, and most personnel are urban planners, architects, engineers and geologists. The professionals from social, economic and other areas only serve as consultants and seldom get involved in the actual planning formulation process. Despite the limited consideration of long-term development strategies in the local reconstruction plans,

however, the detailed non-physical reconstruction strategies are supplemented in various documents gradually released by governments. For example, through 2008 and 2011, the government of Guangdong Province has signed a series of agreements with Wenchuan County to achieve long-term economic cooperation.

6.2.3 Speed versus Deliberation

The top-down planning mechanism is able to achieve rapid reconstruction. All the local reconstruction plans were formulated within 3 months, and the physical reconstruction was finished within three years. However, due to the great tension between speed and deliberation, the fast-speed planning and reconstruction of Wenchuan County also has overlooked some problems which will be discussed below.

6.2.3.1 the top-down planning system in China led to the identical content and structure of local reconstruction plans, which generally have widely-covered content but low analysis depth.

The characteristics of the plans' sustainability indicators are largely related to the top-down planning system of China. Within this system, all the local plans are based on the guidance and requirements set by both central and regional plans. The National Wenchuan Overall Planning for Post-Wenchuan Earthquake Restoration and Reconstruction and its sub plans have stated clearly the contents which should be included in the local plans, including housing, transportation, public facilities, tourism, landscape, infrastructure, and hazard mitigation. Except for a small number of plans that do not include the complete contents, generally all the plans strictly follow the requirements and consequently have the identical planning structure and contents. No plan includes additional planning contents which are not required by the upper-level plans. Consequently, most aspects of sustainable development are included in the plans, which led to the relatively high breadth points in the evaluation. However, some particular aspects are consistently missing in all the plans. For example, no plans include the environmental aspect of transportation system or the development of research industries in the future.

Despite the broad planning content, the average analysis depth is low for most plans. This could be explained by two major factors. Firstly, as stated above, the limited consideration of long-term and non-physical development largely decreases the analysis depth of many aspects for sustainable development. Secondly, under the typical top-down planning system, all the local reconstruction plans of Wenchuan County were formulated as blueprints for the future. Following the routine planning analysis process, all 13 local plans have identical frameworks - the first part is the general introduction of the targeted area and the status quo analysis of both pre- and post-earthquake conditions; after the evaluation of various aspects of the post-earthquake situation, they identify the general development strategies, including population

targets, land utilization, and development orientations based on the guidance and principals provided by the upper-level plans; following the general planning strategies, they then formulate the land use allocation for different functions and provide detailed arrangements for the specific contents. Within the identical planning framework, most contents of the local plans are related to "what should be done" and "how to do" for the post-earthquake recovery and reconstruction, whereas the explanation of "why they should be done" is limited. All these factors lead to the result that the analysis depth of planning contents is generally much lower than their breadth.

6.2.3.2 The excessive emphasis on speed neglects the deliberation of planning formulation and implementation.

Wenchuan post-earthquake reconstruction is conducted strictly within the time framework set by governments, which, on one hand, effectively stimulates timely and efficient actions, yet, on the other hand, leads to hasty actions. Under the time pressure, it is almost impossible for planning and design institutes to finish a comprehensive reconstruction plan with thorough analysis within a short time, and cooperation with professionals from various areas was limited. Moreover, since all the plans were conducted by other provinces which were not familiar with the local situation of the disaster-affected areas, it was difficult to prepare deliberate plans, especially in such a short time. Under this circumstance, most planning and design institutes had to finish the recovery and reconstruction planning as routine work, making use of their advantages of skills physical planning and architecture design, while paying less attention to long-term non-physical planning.

After the earthquake, many Chinese scholars have pointed out that China needs rationality and patience. During the post-disaster recovery and reconstruction process, all the tasks including housing reconstruction, employments, and industrial restoration were all closely related to each other, which needed careful and complete evaluation of the overall situation (Zhang, et al., 2009). Despite the tremendous efforts and great achievements, the speedy recovery and reconstruction planning has some negative consequences. For example, the serious landslide and flood in Yingxiu in August 2010 was largely due to the negligence during the land evaluation process. Many scholars are still questioning the rationality of the location selection of reconstruction sites, worrying that the fragile ecosystem and unstable mountain slopes will bring a high risk of geological disasters in the future. In addition, the above analysis shows that, during the implementation process of economic strategies, some areas had a mismatch between planning and the actual local situation, which will make it difficult to achieve long-term economic development in the future.

6.2.4 Top-down planning vs. bottom-up implementation

As stated above, Wenchuan post-earthquake reconstruction was led by top-down planning typical of the top-down political system. It is undeniable that this system could efficiently organize action at all levels within a short time; in addition, for a large-scale disaster which affects multiple areas, this system may help the central government to effectively achieve regional coordination. However, since all the planning strategies eventually need to be implemented at the local level, this top-down planning system also has some limitations and weakness compared to bottom-up implementation.

6.2.4.1 The chaotic characteristics of post-disaster reconstruction on one hand need strong leadership, but on the other hand make it difficult to achieve effective hierarchical management.

Although China adopted strong hierarchical management during the Wenchuan post-earthquake recovery and reconstruction process, the supervision of local planning implementation was far from sufficient. The Wenchuan earthquake was a large scale disaster in which dozens of recovery and reconstruction plans were conducted by various institutes at the same time. Meanwhile, since within the paired-assisting mechanism most personnel were temporarily transferred from other provinces to local areas, coordination between various local governments and institutes were required during the process. Under this circumstance, most involved institutes faced great challenges to finish the heavy and urgent tasks within the limited time while new demands keep emerging all the time. Despite the large amount of guidance sent out by central and regional governments, the specific actions still needed to rely on strong local-level leadership and supervision. Many scholars have noticed that within the hierarchical management framework of Wenchuan post-disaster reconstruction, some disordered aspects emerged that could bring adverse effects and undermine high-quality planning and reconstruction. Lacking horizontal coordination and effective supervision at the local level, speedy reconstruction can easily go out of control. For example, towns in Wenchuan County are competing with each other to build large-scale earthquake ruins museums or memorials, although it is unclear whether these identical and repetitive reconstructions are reasonable and proper for local culture preservation and economic development (Wu et al., 2009).

In addition, the hierarchical management system created gaps between the expectations of upper-level governments and the actual implementation capability of local governments and institutes. Because the upper-level governments are usually not familiar with local situations, it is quite possible for them to make unpractical goals for local reconstruction. Furthermore, the specific situations of disaster-affected areas vary, requiringunique considerations and arrangements. Hence, the mandatory and unified requirements released by upper-level governments usually do not provide enough flexibility to local implementation and make it difficult for local entities to implement the strategies with high quality.

6.2.4.2 The hierarchical planning and reconstruction still needs public participation at the local level, as well as transparent planning processes to achieve better understanding of the local situation and coordination between governments and the public.

Many studies have pointed out the importance of public participation at the local level during disaster reconstruction processes. Within the top-down planning framework, upper-level governments have to try to understand specific local conditions and formulate proper reconstruction strategies. However, public participation in the Wenchuan post-disaster recovery and reconstruction was mostly a one-sided collection of public opinions by professionals. Consequently, local residents had little opportunity to apply their local knowledge to assist the planning formulation, which may have further aggravated the mismatch between the outcome of reconstruction strategies expected at upper level and actual local implementation.

Furthermore, since reconstruction is related to every aspect of local residents' lives, their limited role during the reconstruction planning process may easily add to their confusion, misunderstanding or even complaints about the reconstruction policies. This situation will be aggravated if the policies are not transparent enough to the public. Some residents may over rely on the governments and institutes to finish reconstruction and passively wait and accept the arrangements; while some others may take actions by themselves regardless of the guidance in reconstruction plans. All of these facts have demonstrated that a low level of public participation will not only affect the quality of reconstruction planning but also bring inconvenience to policy implementation.

6.2.4.3 The hierarchical political and planning system may weaken the role of local governments, and calls for strong governmental leadership at the local level.

Within the hierarchical political system and top-down planning framework, most reconstruction planning strategies were prepared by upper-level governments and implemented by local governments. Since the planning strategies and reconstruction policies usually provide a good vision or promise for the future, local residents always have high expectations toward the actual implementations by local governments. However, many studies have pointed out that the role of local governments during the Wenchuan post-earthquake reconstruction was limited and weak. For example, under the paired-assisting policy, local governments of disaster-affected areas may have overly relied on their assisting cities, while lacking initiative for their own work (Wang, et al, 2010). Meanwhile, their incapability may also arouse the local residents' mistrust and discontent. A study by Chen (2009) indicates hat several primary factors contributed to the incapability of local governments. The factors include: compared to the immediate

emergency response given by the central government, some local governments performed much less efficiently and actively during the reconstruction process; some local governments did not fully implement the reconstruction policies released by upper-level governments; some local governments took advantage of reconstruction to achieve their own political goals by building impractical "image projects" while having less consideration of actual needs of local residents; and some local governments did not make the implementation of reconstruction policies transparent and open enough to the public (Chen, 2009). Within the top-down political system, disaster reconstruction still needs strong, effective and responsible leadership at the local level, which serves as a crucial connection between the upper-level governments and the local residents, as well as between the upper-level policies and local implementation based on the actual situation.

6.2.5 Economic assistance vs. independent economic development

For long-term sustainable development, it is impossible for disaster-affected areas to passively accept external assistance forever. It is important to set up practical recovery strategies based on local situations and market mechanisms and stimulate local areas to achieve independent socio-economic development.

One major characteristic of Wenchuan post-earthquake recovery and reconstruction is that Wenchuan County was able to receive a great amount of funds and assistance from both the central government and governments of the paired region. During the three-year reconstruction period, the primary reconstruction strategy was in the form of a planned economy to achieve resource distribution and allocation (Yang, et al., 2009). However, after finishing the physical reconstruction, Wenchuan County will face a great challenge to achieve independent and sustained economic development. Guangdong Province has introduced several strategies intended to help Wenchuan County solve the problem of long-term economic development. However, whether these strategies can be successfully applied to the actual situation of Wenchuan County is still under discussion. For example, is there enough tourist market to support the tourism development in so many towns of Wenchuan County in the long term? Is it practical for Wenchuan County to achieve development through the transition from traditional extensive industries to intensive high-tech industries in a short time? Will local residents and the social environment be adaptive to the changing economic environment after reconstruction? All these questions need to be given full consideration for long-term post-disaster reconstruction planning.

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APPENDIX

1. International Urban Sustainability Indicators List (IUSIL)

Category		Indicator	
		Environmental	
En1	Geographically balanced settlement	En1-1	Population growth
		En1-2	Planned settlements
En2	Freshwater	En2-1	Proportion of total water resources used
		En2-2	Water use intensity by economic activity
		En2-3	Presence of faecal coliforms in freshwater
		En2-4	Biochemical oxygen demand in water bodies
En3	Wastewater	En3-1	Percentage of city population served by wastewater collection
		En3-2	Percentage of wastewater receiving no/primary/secondary/tertiary treatment
En4	Quality of ambient air and atmosphere	En4-1	Number of times the limit values for selected air pollutants are exceeded
		En4-2	Existence and level of implementation of air quality management plan
		En4-3	Emissions of greenhouse gases
		En4-4	Consumption of ozone depleting substances
En5	Noise pollution	En5-1	Share of population exposed to long-term high level of environmental noise
		En5-2	Noise levels in selected areas
		En5-3	Existence and level of implementation of a noise action plan
En6	Sustainable land use	En6-1	Artificial surfaces as a percentage of the total municipal area.
		En6-2	Extent of derelict and contaminated land
		En6-3	Number of inhabitants per Km2
		En6-4	Quota of new edification taking place on virgin area and quota taking place on derelict and contaminated land in % per year.
		En6-5	Restoration of urban land
			a) Renovation, conversion of derelict buildings
			b) Redevelopment of derelict land for new urban uses
			c) Cleansing of contaminated land
		En6-6	Protected areas as a percentage of total municipal area
		En6-7	Land affected by desertification
		En6-8	Area under organic farming
		En6-9	Proportion of land area covered by forests
En7	Waste generation and management	En7-1	Percentage of city population with regular solid waste collection
		En7-2	Percentage of solid waste disposed to sanitary landfill/incinerated and burned openly/disposed to open dump/recycled/other
		En7-3	Total solid waste generation per capita
		En7-4	Generation of hazardous waste

		En7-5	Waste treatment and disposal
		En7-6	Management of radioactive waste
En8	Effective and environmentally sound transportation systems	En8-1	Travel time
		En8-2	Transport modes
		En8-3	Energy intensity of transport
En9	Mechanisms to prepare and implement environmental plans	En9-1	Local environmental plans
		En9-2	Latest approval date of Master Plan
En10	Biodiversity	En10-1	Proportion of terrestrial area protected
		En10-2	Management effectiveness of protected areas
		En10-3	Area of selected key ecosystems
		En10-4	Fragmentation of habitats
		En10-5	Change in threat status of species
		En10-6	Abundance of selected key species
		En10-7	Abundance of invasive alien species
Economic			
Ec1	Consumption and production patterns	Ec1-1	Material consumption
		Ec1-2	Material intensity of the economy
		Ec1-3	Domestic material consumption
		Ec1-4	Annual energy consumption, total and by main user category
		Ec1-5	Share of renewable energy sources in total energy use
		Ec1-6	Intensity of energy use, total and by economic activity
Ec2	Economic development	Ec2-1	Macroeconomic performance
			a) Gross domestic product (GDP) per capita
			b) Gross saving
			c) Investment share in GDP
			d) Adjusted net savings as percentage of gross national income (GNI)
			e) Inflation rate
		Ec2-2	Employment
			a) Employment-population ratio
			b) Vulnerable employment
			c) Labor productivity and unit labor costs
			d) Share of women in wage employment in the non-agricultural sector
		Ec2-3	Information and communication technologies
			a) Internet users per 100 population
			b) Fixed telephone lines per 100 population
			c) Mobile cellular telephone subscribers per 100 population
		Ec2-4	Research and development
			a) Gross domestic expenditure on Research and Development as a percent of GDP
		Ec2-5	Tourism
			a) Tourism contribution to GDP
Ec3	Finance	Ec3-1	Debt service ratio
		Ec3-2	Tax collected as percentage of tax billed

		Ec3-3	Own-source revenue as a percent of total revenues
		Ec3-4	Capital spending as percentage of total expenditures
Ec4	Water	Ec4-1	Price of water
		Ec4-2	Domestic water consumption per capita
Ec5	Strengthen small and microenterprises	Ec5-1	Informal employment
Social			
So1	Energy Access	So1-1	Percentage of city population with authorized electrical service
		So1-2	Total electrical use per capita
		So1-3	Number and duration of electrical interruptions per year per customer
So2	Water Access	So2-1	Percentage of city population with potable water supply service
		So2-2	Number of interruptions in water service
So3	Education	So3-1	Percentage of children completion and secondary education
		So3-2	Percentage of school aged children enrolled in schools (by gender)
		So3-3	Student/teacher ratio
So4	Health	So4-1	Mortality
			a) Under-five
			b) Mortality rate
			c) Life expectancy at birth
			d) Healthy life expectancy at birth
		So4-2	Health care delivery
			a) Percent of population with access to primary health care facilities
			b) Contraceptive prevalence rate
			c) Immunization against infectious childhood diseases
		So4-3	Nutritional status
			a) Nutritional status of children
		So4-4	Health status and risks
			a) Morbidity of major diseases such as HIV/AIDS, malaria, tuberculosis
			b) Prevalence of tobacco use
			c) Suicide rate
So5	Safety	So5-1	Number of homicides per 100,000 population
		So5-2	Number of sworn police officers per 100,000 population
		So5-3	Violent crime rate per 100,000 population
So6	Fire & Emergency Response	So6-1	Number of firefighters per 100,000 population
		So6-2	Number of fire related deaths per 100,000 population
		So6-3	Response time for fire department from initial call
So7	Poverty	So7-1	Income poverty
			a) Proportion of population living below national poverty line
			b) Proportion of population below $1 a day
		So7-2	Income inequality
			a) Ratio of share in national income of highest to lowest

			quintile
So8	Transportation	So8-1	Km of transportation system per 100,000 population
		So8-2	Annual number of public transit trips per capita
		So8-3	Commercial Air Connectivity
		So8-4	Average travel speed on primary thoroughfares during peak hours
		So8-5	Transportation fatalities per 100,000 population
		So8-6	Number of daily trips and time taken per capita by type of trip and by mode of transport
		So8-7	Total average daily distance covered per capita by type of trip and by mode of transport
		So8-8	Mode of transportation used by children to travel between home and school
So9	Natural hazards	So9-1	Percentage of population living in hazard prone areas
		So9-2	Human and economic loss due to natural disasters
		So9-3	Disaster prevention and mitigation instruments
So10	Adequate housing	So10-1	Durable structures
		So10-2	Overcrowding
		So10-3	Right to adequate housing
		So10-4	Housing price and rent-to-income
So11	Shelter	So11-1	Percentage of city population living in slums
		So11-2	Area size of informal settlements as a percent of city area and population
So12	Security of tenure	So12-1	Secure tenure
		So12-2	Authorized housing
		So12-3	Evictions
So13	Access to credit	So13-1	Housing finance
So14	Access to land	So14-1	Land price -to-income
So15	Promote social integration and support disadvantaged groups	So15-1	Poor households
So16	Culture	So16-1	Number of cultural establishments per 100,000 population
		So16-2	City expenditures on culture as a percentage of overall city budget
So17	Recreation	So17-1	Square meters of public recreation facility space per capita
		So17-2	City expenditures on public recreation as a percentage of overall city budget
So18	Availability of local public green areas and local services	So18-1	Citizens' access to nearby public green areas and basic services
Governance			
Go1	Participation and civic engagement	Go1-1	Citizens participation
		Go1-2	Voters participation
		Go1-3	Civic associations
Go2	Transparent, accountable and efficient governance	Go2-1	Transparency and accountability
Go3	Government	Go3-1	Corruption

		Go3-2	Percentage of population having paid bribes
Go4	Sustainable management of the authorities and businesses	Go4-1	Share of public and private organizations adopting and using environmental and social management procedures

2. China Seismic Intensity Scale (CSIS)

The China Seismic Intensity Scale (CSIS) is a national standard in the People's Republic of China used to measure seismic intensity. Similar to EMS-92 on which CSIS drew reference, seismic impacts are classified into 12 degrees of intensity or Liedu in Roman numerals from I for insensible to XII for landscape reshaping. The scale was initially formalized by the China Earthquake Administration (CEA) in 1980, therefore often referred to by its original title as "China Seismic Intensity Scale (1980)". It was later revised, and adopted as a national standard, series GB/T 17742-1999 by then National Quality and Technology Supervision Administration (now General Administration of Quality Supervision, Inspection, and Quarantine of P.R.C., AQSIQ) in 1999.The standard was set for revision not long before the 2008 Wenchuan earthquake.

Table 2: Table of Intensity/Liedu

Liedu (Intensity)	Senses by people on the ground	Degree of building damage		Other damages	Horizontal motion on the ground	
		Damages	Mean damage index		Peak acceleration /S^2	Peak speed m/s
I	Insensible					
II	Sensible by very few still indoor people					
III	Sensible by a few still indoor people	Slight rattle of doors and windows		Slight swing of suspended objects		
IV	Sensible by most people indoors, a few people outdoors; a few wake up from sleep	Rattle of doors and windows		Obvious swing of suspended objects; vessels rattle		
V	Commonly sensible by people indoors, sensible by most people outdoors; most wake up from sleep	Noise from vibration of doors, windows, and building frames; falling of dusts, small cracks in plasters, falling of some roof tiles, bricks falling from a few roof-top		Rocking or flipping of unstable objects	0.31 (0.22 - 0.44)	0.03 (0.02 - 0.04)

		chimneys				
VI	Most unable to stand stably, a few scared to running outdoors	Damages - Cracks in the walls, falling of roof tiles, some roof-top chimneys crack or fall apart	0 - 0.10	Cracks in river banks and soft soil; occasional burst of sand and water from saturated sand layers; cracks on some standalone chimneys	0.63 (0.45 - 0.89)	0.06 (0.05 - 0.09)
VII	Majority scared to running outdoors, sensible by bicycle riders and people in moving motor vehicles	Slight destruction - localized destruction, crack, may continue to be used with small repairs or without repair	0.11 - 0.30	Collapse of river banks; frequent burst of sand and water from saturated sand layers; many cracks in soft soils; moderate destruction of most standalone chimneys	1.25 (0.90 - 1.77)	0.13 (0.10 - 0.18)
VIII	Mostly swing about, difficult to walk	Moderate destruction - structural destruction occurs, continued usage requires repair	0.31 - 0.50	Cracks appear in hard dry soils; severe destruction of most standalone chimneys; tree tops break; death of people and cattle caused by building destruction	2.5 (1.78 - 3.53)	0.25 (0.19 - 0.35)
IX	Moving people fall	Severe destruction - severe structural destruction, localized collapse, difficult to repair	0.51 - 0.70	Many cracks in hard dry soils; possible cracks and dislocations in bedrock; frequent landslides and collapses; collapse of many standalone chimneys	5 (3.54 - 7.07)	0.5 (0.36 - 0.71)
X	Bicycle riders may fall; people in unstable state may fall away; sense of being thrown up	Most collapse	0.71 - 0.90	Cracks in bedrock and earthquake fractures; destruction of bridge arches founded in bedrock; foundation damage or collapse of most standalone chimneys	10 (7.08 - 14.14)	1 (0.72 - 1.41)
XI		Wide spread collapse	0.91 - 1.00	Earthquake fractures extend a long way; many bedrock cracks and landslides		
XII				Drastic change in landscape, mountains, and rivers		

3. Chinese government structure

All power within the government of the People's Republic of China is divided among three bodies: the Communist Party of China, the Central People's Government (State Council), and the People's Liberation Army (PLA). The State Council of the People's Republic of China is the chief administrative authority of the People's Republic of China, which directly oversees the various subordinate People's Governments in the provinces. There are 22 ministries in the State Council of the People's Republic of China.

Table 3: List of ministries under the State Council of the People's Republic of China

Name of Ministry	Responsibility
Ministry of Foreign Affairs	In charge of the relations between the People's Republic of China and other countries in the world.
Ministry of National Defense	Exercise unified administration over the development of the armed forces of the country such as recruitment, organization, equipment, training, scientific military research of the People's Liberation Army (PLA) and the ranking and remuneration of the officers and servicemen
Ministry of Education	Regulate all aspects of the educational system in mainland China. This includes compulsory basic education, vocational education and tertiary education
Ministry of Science and Technology	Coordinates science and technology activities in the country
Ministry of Industry and Information Technology	Regulate and develop the postal service, Internet, wireless, broadcasting, communications, production of electronic and information goods, software industry and the promotion of the national knowledge economy
Ministry of Public Security	Exercise oversight over and is ultimately responsible for day-to-day law enforcement
Ministry of State Security	Ensure the security of the state through effective measures against enemy agents, spies, and counter-revolutionary activities
Ministry of Supervision	Responsible for maintaining an efficient, disciplined, clean and honest government, and educate public servants about their duty and discipline
Ministry of Civil Affairs	Responsible for social and administrative affairs
Ministry of Justice	In charge of judicial process, drafting legislation, developing legal framework, participating in national and international treaties, prosecution and sentencing
Ministry of Finance	Administer macroeconomic policies and the national annual budget; handles fiscal policy, economic regulations and government expenditure
Ministry of Human Resources and Social Security	In charge of national labor polices, standards, regulations and managing the national social security
Ministry of Land and Resources	In charge of regulation, management, preservation and exploitation of natural resources, such as land, mines and oceans
Ministry of Environmental Protection	Protect China's air, water, and land from pollution and contamination
Ministry of Housing and Urban-Rural Development	Provides housing and regulates the state construction activities in the country
Ministry of Transport	Responsible for road, air and water transportation regulations

Ministry of Railways	Responsible for passenger services, regulation of the rail industry, development of the rail network and rail infrastructure in mainland China
Ministry of Water Resources	Responsible for managing the water resources in China
Ministry of Agriculture	Responsible for formulating policy on foreign trade, export and import regulations, foreign direct investments, consumer protection, market competition and negotiating bilateral and multilateral trade agreements
Ministry of Commerce	Responsible for formulating policy on foreign trade, export and import regulations, foreign direct investments, consumer protection, market competition and negotiating bilateral and multilateral trade agreements
Ministry of Culture	Responsible for culture policy and activities in the country
Ministry of Health	Responsible for providing information, raising health awareness and education, ensuring the accessibility of health services, and monitoring the quality of health services provided to citizens and visitors